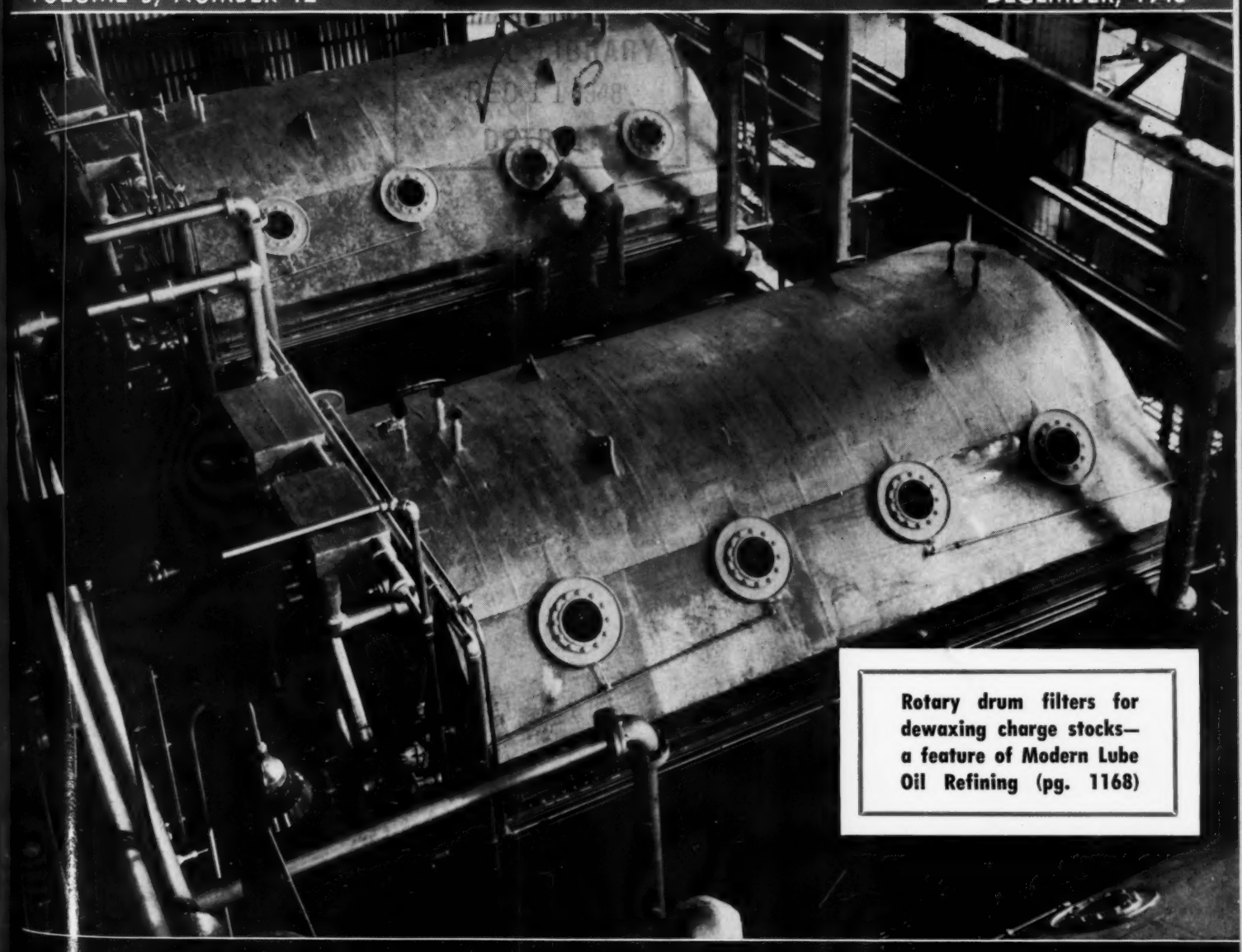
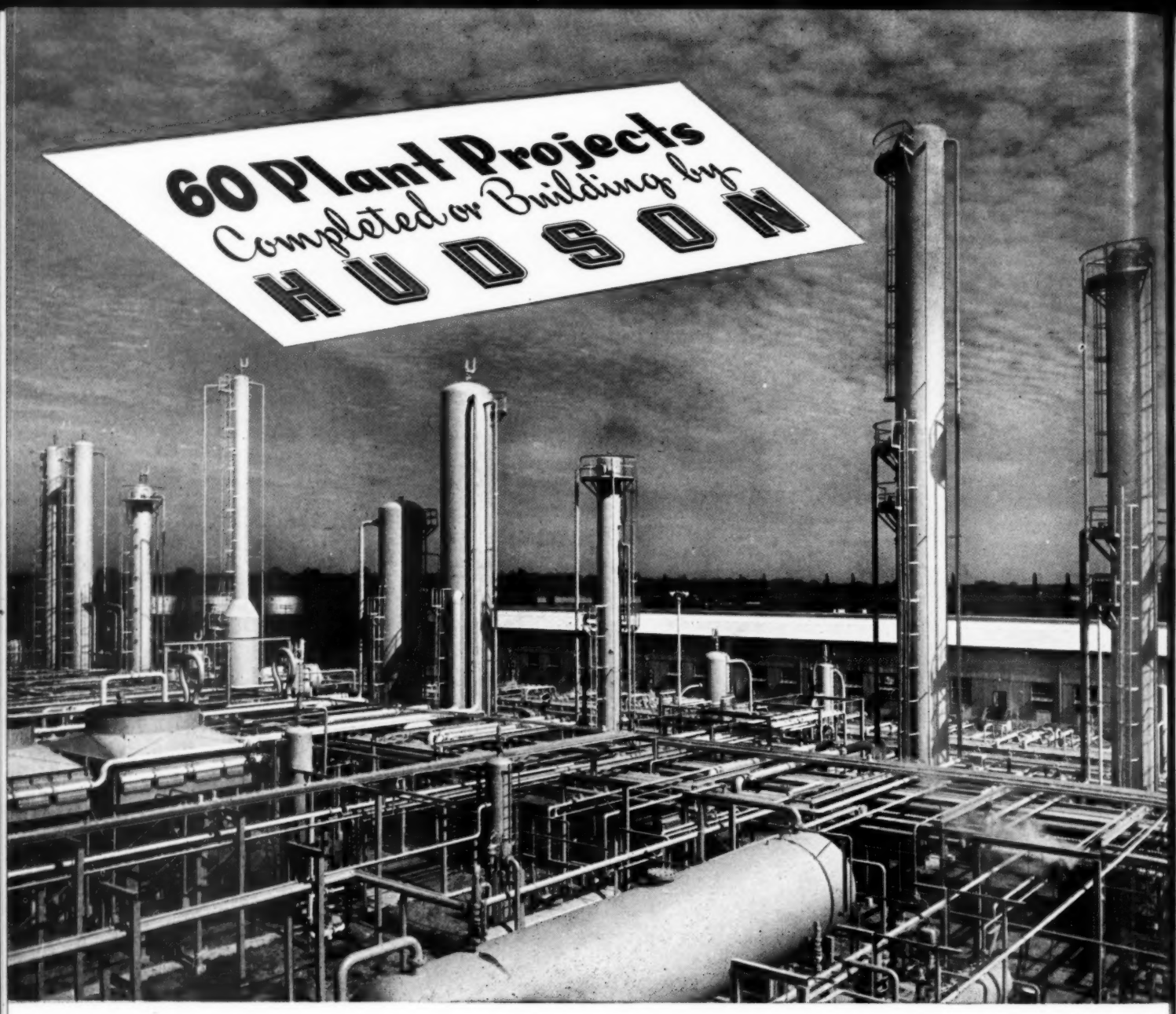
PETROLEUM PROCESSING

VOLUME 3, NUMBER 12 DECEMBER, 1948



Rotary drum filters for dewaxing charge stocks—a feature of Modern Lube Oil Refining (pg. 1168)

FORMERLY MONTHLY TECHNICAL SECTION OF NATIONAL PETROLEUM NEWS



Pictured above is the first gas processing plant to operate in Mississippi, designed and constructed by HUDSON for the operators in the Cranfield Field of Adams County.

Experience

The experience of the HUDSON organization in designing and building complete plants for gas processing results in: ***Advanced Process Design . . . Speed in Design, Procurement and Construction . . . Minimum Overall Cost of Processing . . . and*** **Satisfied Clients.**

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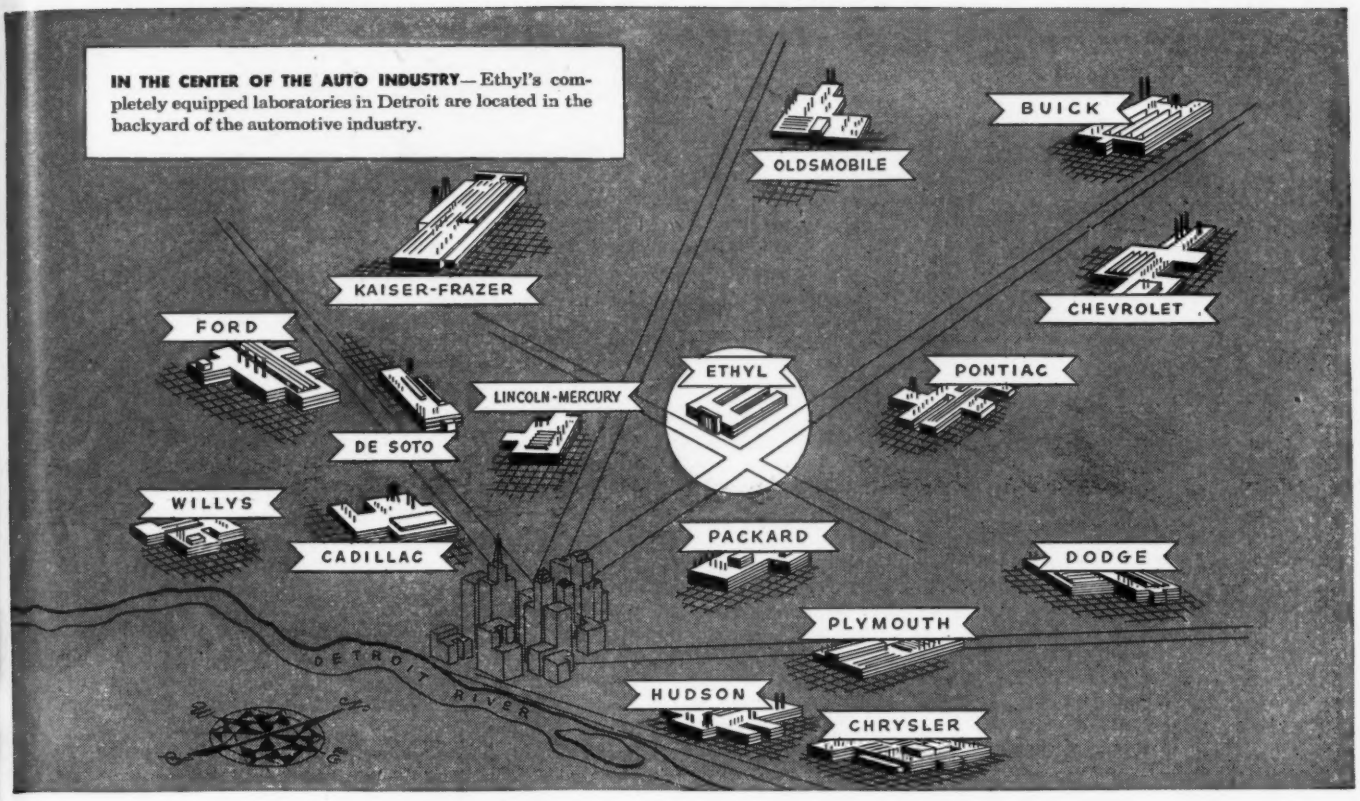
PLANTS • ATMOSPHERIC AND VACUUM DISTILLATION UNITS



Ethyl Laboratories interpret engine trends

IN ORDER to help refiners keep abreast of the planning of engineers so far as it relates to the fuel requirements of engines, it has been Ethyl's policy to maintain close contact with the manufacturers of engines and to devote a part of its research to investigations of possible future engines. Ethyl engineers study the performance of a variety of fuels in supercharged engines and in engines having compression ratios in the range expected to be in use in the period ahead. Every effort is made to relate the gasoline preferences of engines to the molecular structure of fuels and to interpret the "severity" of future engines in terms of base lines established on single-cylinder engines.

A study of fuels in vehicles recently completed by Ethyl Laboratories highlights the extent to which engine performance is affected by the hydrocarbon composition of fuels.

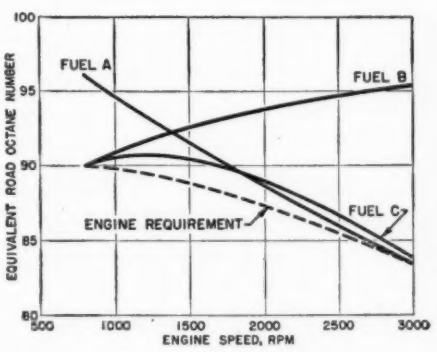
The chart shows the road octane number—over a range of speeds—for three types of fuels: A—unsaturated, B—saturated, C—selectively blended. Curves are plotted from road ratings obtained on an experimental valve-in-head engine of 8 to 1 compression ratio. Octane requirement of the engine is shown as a broken line.

Fuel A, at low speed, has an octane number six units higher than the engine needs, but just meets the requirement at high speed. On the other hand, Fuel B, at high speed, has an octane number twelve units higher than the engine requirement but has no excess of antiknock quality at low speed. Selectively blended Fuel C, in contrast to both fuels A and B, satisfies the engine requirement curve over the entire speed range with virtually no waste of antiknock quality at any speed.

Research of this type is just one of Ethyl's services to refiners. The objective of this service is to assist oil companies in their efforts to make satisfactory fuels for future engines at the lowest cost and to obtain the maximum value from each drop of "Ethyl" brand of antiknock compound.

The strategic location of Ethyl's Research Laboratories at Detroit makes possible close relationships with engineers. These relationships assist in the formulation of research programs designed for the benefit of oil companies.

Road antiknock performance of three types of fuels in an experimental high compression engine on the road.



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ETHYL CORPORATION

RESEARCH LABORATORIES

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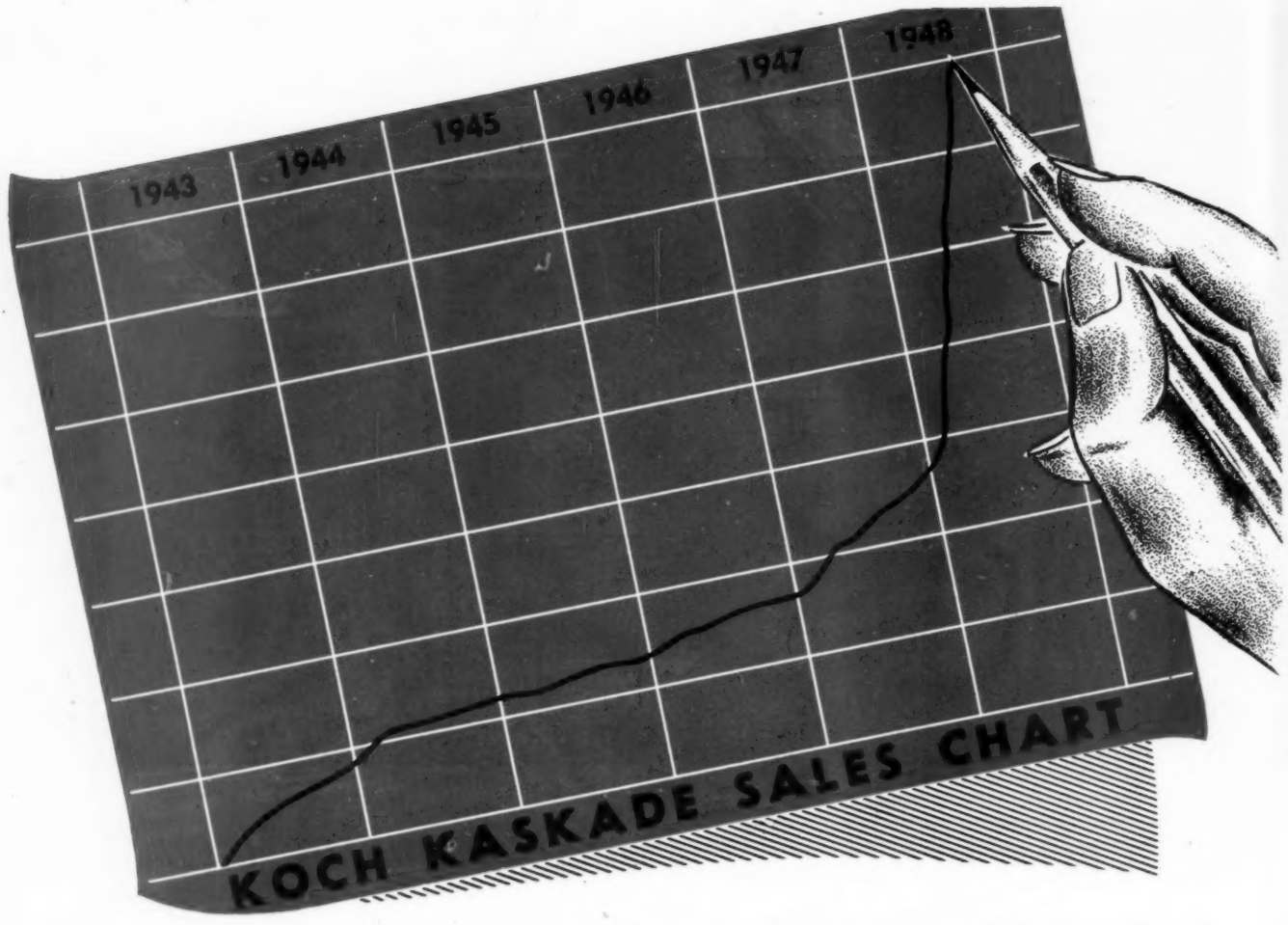


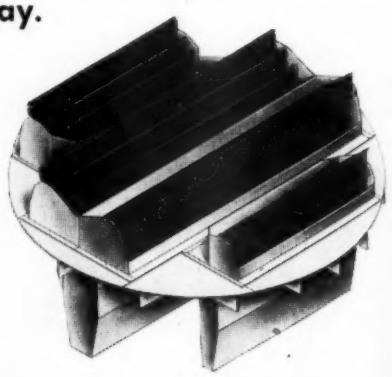
New Ideas Take Hold Slowly

But

The Koch Kaskade Tray is finding wide acceptance — over 500 Koch Kaskade Trays were ordered in one month.

Why?

Because **— It has 30-50% more capacity and is 25% more efficient than the best bubble tray.**



There is no equipment in your refinery more important than the fractionating devices. Why not use the outstanding one.

INQUIRIES ARE WELCOME — NO OBLIGATION OF COURSE
SEND FOR BULLETIN

KOCH ENGINEERING COMPANY, INC.

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★ BRITISH ASSOCIATES: MESSRS. A. F. CRAIG & COMPANY, LTD., PAISLEY, SCOTLAND ★

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VOLUME 3
NUMBER 12
DECEMBER, 1948
PUBLISHED
MONTHLY

PETROLEUM PROCESSING

OTHER PLATT PUBLICATIONS:
NATIONAL PETROLEUM NEWS
OILGRAM NEWS
OILGRAM PRICES
PLATTS'S OIL PRICE HANDBOOK

Covering the Management, Design, Operation, Equipment, Products of Plants Processing Crude Oil and Natural Gas into Fuels, Lubricants, Chemicals

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★ **Indicates Exclusive in PETROLEUM PROCESSING**

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MARATHON
OHIO GOES Fluid
Right now, in Robinson, Illinois, a UOP Improved Fluid Catalytic Cracking Unit is being erected at the refinery of The Ohio Oil Company.
Ohio is another well known name added to the rapidly increasing list of refiners who have selected UOP Fluid Units . . . refiners that understand the importance of selecting a design that will afford the very utmost in processing efficiency and economy.
The UOP Improved Fluid Catalytic Cracking Unit has earned acceptance by leading refiners, and Ohio's decision means that the products of another UOP Fluid Unit will soon be sold under the banner of one of the most progressive companies.
ROCK ISLAND
ROCK ISLAND GOES Fluid
Another UOP Improved Fluid Catalytic Cracking Unit . . . this time for Rock Island Refining Corporation for installation at their refinery near Indianapolis.
Designed to handle 5,000 barrels of gas oil per day, the new unit will be of the combined reactor-regenerator type and will utilize the already existing feed preparation, Thermal Cracking fractionator and debutanizer equipment. Procurement of materials is being handled by Franklin Supply Company.
Rock Island's decision adds another name to the ever growing list of refiners who recognize the distinct advantages of the flexibility and economy afforded by Universal's improved design and modern engineering techniques.
UNIVERSAL OIL PRODUCTS COMPANY
CHICAGO 4, ILLINOIS, U. S. A.
LABORATORIES: RIVERSIDE, ILLINOIS
Universal Service Protects Your Refinery
CONOCO
CONTINENTAL GOES Fluid
Continental Oil Company have decided to install a Fluid Catalytic Cracking Unit in their new refinery at Billings, Montana.
This unit will be engineered and licensed by Universal, while the over-all refinery engineering and construction will be handled by Jones and Laughlin Supply Company.
Continental's decision to install fluid catalytic cracking is continuing proof of the decided trend toward the flexible fluid process.
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IT'S THE UOP IMPROVED
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LABORATORIES: RIVERSIDE, ILLINOIS
Universal Service Protects Your Refinery

SOHIO
ANOTHER VOTE FOR Fluid
Improvements to Sohio's Lima, Ohio, refinery will include installation of a UOP-engineered fluid catalytic cracking unit. Result: flexibility in the processing of 16,000 barrels of fresh charge per stream day.
A gas recovery system, too, will be engineered by UOP for the same refinery.
Standard of Ohio's decision adds another familiar emblem under which the products of a UOP Improved Fluid Catalytic Cracking Unit will be marketed...presents additional proof of the confidence that successful refiners have placed in the fluid process.
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LABORATORIES: RIVERSIDE, ILLINOIS
Globe
GLOBE GOES Fluid
One more UOP Improved Fluid Catalytic Cracking Unit will soon go to work. It will be installed at the Lemont, Illinois, refinery of The Globe Oil & Refining Co., supplier of a wide range of products to independent jobbers.
Utilizing existing feed preparation equipment and combining reactor and regenerator in a single column, the new unit will handle 6,000 barrels of heavy vacuum gas oil per stream day at 50 percent conversion level.
Globe chose the UOP Improved Fluid Catalytic Cracking Unit for *flexibility* and *economy*...advantages that are paying off day after day to an ever growing list of refiners.
HIGHER
COSDEN
OCTANE
COSDEN GOES Fluid
Again the UOP Improved Fluid Catalytic Cracking Unit is specified . . . this time by Cosden Petroleum Corp. for installation at the company's Big Spring, Texas, refinery.
With a capacity of 6,000 barrels of heavy vacuum gas oil per stream day at 50 percent conversion level, the new unit will take advantage of feed preparation equipment already in existence. Employing the economy of design typical of the UOP unit, reactor and regenerator will be combined in a single tower.
Cosden is one more progressive refiner to recognize Fluid's simplicity, flexibility, economy, maximum liquid yields and higher product quality . . . one more refiner to take advantage of Universal's improved Fluid design.
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LABORATORIES: RIVERSIDE, ILLINOIS
Universal Service Protects Your Refinery
WOOD RIVER
WOOD RIVER GOES Flu
The Wood River Oil & Refining Co., Inc. soon will in Improved Fluid Catalytic Cracking Unit at the company's Hartford, Illinois, refinery.
Chosen because of its ability to produce a wide range of quality products, this Fluid unit will enable Wood River to keep abreast of market demands and afford the flexibility and economy that is so important to a successful processing operation.
Here is continuing proof of Fluid preference on the part of progressive refiners . . . positive evidence that the Universal Fluid design has earned the confidence of those who demand the best in Fluid units.
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AEROCAT* SYNTHETIC FLUID CRACKING CATALYSTS

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What's Happening!

DECEMBER 1
1948

Important Current News Summarized for Refiners

EXPANSION

Continental Oil Co.'s expanded Denver refinery (upped to 6750 b/d from 3500 b/d) went on stream last month with completion of a $5,800,000 enlargement program launched in June, 1947. Facilities now include catalytic cracking (TCC), new vapor recovery and gasoline stabilization unit, catalytic polymerization, and enlarged LPG facilities, in addition to existing refining units.

McColl-Frontenac Oil Co., Ltd., Canadian affiliate of The Texas Co., is now completing new grease manufacturing and lubricating oil compounding facilities at its Toronto refinery which will double current output. Plant is designed to process 10 million Imperial gallons of lubricating oils and 12 million pounds of grease and gear lubricants annually.

Ethyl Corp. will build its seventh TEL manufacturing plant at Baton Rouge, duplicating in size and capacity a sixth plant now under construction there. Expansion step is being taken, company states, because of oil industry forecasts of continuing increases in gasoline production over the next five years, plus anticipated improvement in gasoline quality during this period—all of which will increase demand for TEL. Completion of latest plant is expected late in 1950.

Esso Standard Oil Co. has started construction of a six-story main office building and a two-story cafeteria at its Baton Rouge refinery, both of which are expected to be completed in early 1950. The office building will contain approximately 170,000 sq. ft. of floor space, and the cafeteria will be capable of accommodating 450 diners per sitting.

• • •

SYNTHETIC FUELS

A coal-to-oil plant in Alaska is being given serious consideration by the Army, in order to supply the territory's military fuel requirements and provide a cushion for possible emergency needs. Army engineers have already made a survey, it is reported, and three general areas suitable as sites for such a plant have been designated. Size of plant being considered would be from 7000 to 10,000 b/d, and would cost from $112 million to $200 million, it is estimated.

A $500,000 pilot plant to study coal gasification has been put into operation at Library, Pa., by Pittsburgh Consolidation Coal Co. The plant, formally opened Nov. 15, employs Jersey Standard's fluidized solids technique, and is part of a research project on synthetic fuels now being carried on jointly by Standard Oil Development Co. and Pittsburgh Consolidation. (More details in this issue, pg. 1173.)

Development of a commercial synthetic fuels industry by "private industry" is favored by Sen. O'Mahoney (D., Wyo.), who is slated to be chairman of the important Interior and Insular Affairs Committee, which will handle most petroleum matters in the Senate. O'Mahoney has indicated that he does not look with favor on the Wolverton Bill (H. R. 5475), introduced in the last Congress and designed to provide government financing of synthetics plants. Instead, he prefers legislation to provide tax-depreciation measures for private venture in the commercial synthetic liquid fuels field, and indicated that he would again introduce such measures in the new Congress.

• • •

MARKETS, PRICES

November saw a contra-seasonal downward swing in heavy fuel prices, and further easing of prices for practically all other refined products, in the area east of the Rocky Mountains. Trend of prices on the west coast was the reverse, with major refineries there advancing gasoline 0.2c, light fuel 0.4c, bunker and diesel fuels 10 to 17c per bbl., to compensate for higher labor and supply costs.

A 20 to 22c per bbl. drop in heavy fuel was the first major break in prices for a principal refined product at the Gulf and along the Atlantic coast since the war. Reduced prices for Bunker C fuel were $2.30 at New Orleans and Houston, $2.80 at New York and Philadelphia. In Oklahoma, No. 6 oil was down another 25c to new postwar low of $1.50 per bbl.

Sinclair Nov. 24 met the 35c per bbl. increase in crude prices posted late in September by Phillips Petroleum Co., marking the first break in the solid opposition of major crude buyers to the Phillips' boost. Following the Sinclair move, some major crude buyers said they were prepared to lose domestic connections and planned to increase their imports rather than to meet Sinclair and Phillips.

Higher TEL prices have been announced by both suppliers of this additive following the Nov. 1 increase in the price of metallic lead (up 2c to 21.5c a lb.) Effective Feb. 1, 1949, Ethyl's new prices are 63.23c per lb. of TEL content for motor mix (about

Information on these pages is obtained through the nation-wide news coverage services of PLATT'S OILGRAM NEWS

0.23c per cc.) and 68.72c per lb. of TEL content for aviation mix (about 0.25c per cc.) Also effective Feb. 1, DuPont's prices will be raised to 38.9c per lb. of motor mix and 42.2c per lb. of aviation mix. Note that in one case these prices are based on the weight of the mix, and in the other on the amount of TEL in the mix.

Lube oil prices continued downward with Pennsylvania bright stock and neutral off 2c per gal. to 28c and 26c respectively.

• • •

LABOR

All west coast refiners but one had settled their labor difficulties with the Oil Workers International Union by the end of the month—with the union accepting 12.5c an hour increases. No agreement was in sight, however, between Union Oil Co. of California and the OWIU, with the company maintaining that no more jobs were available at its Wilmington refinery, and only a few at its Oleum refinery.

"This situation," President Reese H. Taylor explained in a letter sent to employees Nov. 16, "has been brought about because of two factors: first, our decision to discontinue our own maintenance work at the refineries (this is now being done by independent contractors) and second, the fact that we have filled some of the strikers' jobs with new employees."

OWIU, meanwhile, was displaced as the collective bargaining agency for workers in California Standard's Richmond refinery in an election held Nov. 17 and 18, with Independent Union of Petroleum Workers receiving 1011 votes against 752 for OWIU.

• • •

SPECIFICATIONS

Revised jet fuel specifications have been drawn up to improve availability of product for armed forces, and performance tests on the fuel are now being made at Air Force's Wright Field at Dayton, Ohio. Grade of fuel now being used by military, JP-1, is similar to kerosine and comes from narrow cut on the barrel of crude. Proposed specification, designated JP-3, is considerably broader and represents a move away from middle distillates into the gasoline range.

Fewer lube oil classifications are now being more actively proposed by various members of the industry. At a "Symposium on Motor-Oil Classification" held during recent API meeting in Chicago, consensus of individual speakers was that no more than six classifications of crankcase oils would be necessary to meet practically all needs. At present there are seven SAE classifications (10 through 70) and two Automotive Manufacturers' classifications (10w and 20w), with a third now being proposed (5w).

TRANSITION

Carter Oil Co. has sold its 2000 b/d refinery at Lovell, Wyo., to Husky Refining Co. for an undisclosed amount. Decision to sell was reached when it was determined that other Carter refineries could produce sufficient products to care for the company demands, and that Carter's 20,000 b/d refinery under construction at Billings, Mont., would be completed in time to meet heavier requirements in 1949.

Sinclair's 13,000 Coffeyville, Kans., refinery will be shut down sometime before the year's end and the site converted for use as a pipe line outlet and marketing terminal. Company recently shut down its Ft. Worth refinery and has just about completed shutting down its Kansas City plant. Moves are part of company plans to centralize refinery operations in larger, more efficient plants and to deliver products to other areas by pipe line.

• • •

PRODUCTS

Non-flammable aircraft hydraulic fluid that will not ignite when subjected to a 5000° F. flame has been developed by California Research Corp., and has now been put on the market by the parent company, California Standard. The new fluid is made from a petroleum gas, retains its fluidity and other necessary characteristics from −70° to +250° F., is non-corrosive to all metals used in aircraft, and lubricates at pressures exceeding 3000 psi.

U. S. motorists are spending up to a quarter of a billion dollars unnecessarily for premium motor fuels to be used in cars which were designed for regular grade gasoline, E. Ray Cory of Austin, Minn., chairman of the Committee on Consumer Relations, told the 46th annual meeting of the American Automobile Assn. at San Antonio.

• • •

REFINERY OPERATIONS

Crude runs to stills were on the upswing last month but didn't quite get as high as the all-time record of 5,791,000 b/d set in July. Peak was reached during week ending Nov. 13, when average crude runs was 5,712,000 b/d, 94.0 % of capacity.

Crude production started off the month with a new high for the fifth consecutive week, reaching 5,626,700 b/d for week ending Nov. 6.

Dubbs unit at Ashland Oil & Refining Co.'s No. 1 plant near Catlettsburg, Ky., set a new record for length of run without a clean-out, operating 213.58 days, or 5126 hours. Previous record was slightly less than 171 days, set by Sunray at Allen, Okla.

POWELL makes a *complete* line of valves designed for OIL REFINERIES

More than a hundred years ago Powell adopted a policy. This was to make valves *only* and to make *every kind* of valve that industry might require.

And through the years, strict adherence to this policy has built such a complete line of valves that today there's a Powell Valve for every known industrial flow control service. This includes Bronze and Iron Valves of all required types and designs; Cast Steel Valves of all types in pressure classes from 150 to 2500 pounds; and Corrosion Resistant Valves—including many special designs—made in the widest variety of metals and alloys ever used in making valves.

The Wm. Powell Co., Cincinnati 22, Ohio

DISTRIBUTORS AND STOCKS IN ALL PRINCIPAL CITIES

Fig. 1460—125-pound Iron Body Bronze Mounted or All Iron "Master Pilot" Gate Valve.

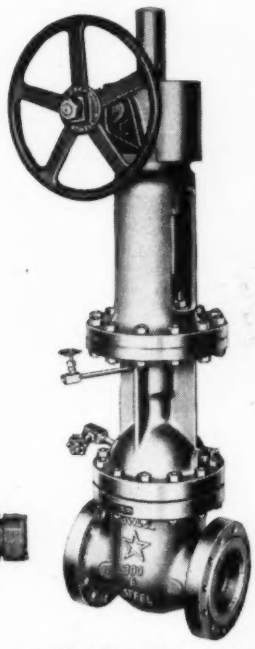

Fig. 3003 S. S. Mod. — Class 300-pound Cast Alloy Steel Gate Valve for ultra high temperatures as in T. C. C. Has drain valves in stuffing box and bonnet. Also cooling fins to dissipate the heat. Gear operated.

Fig. 1793—Large 125-pound Iron Body Bronze Mounted O.S.& Y. Gate Valve.

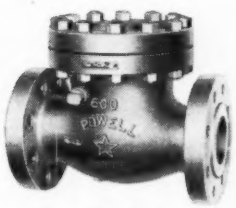

Fig. 6061—Class 600-pound Cast Steel Swing Check Valve.

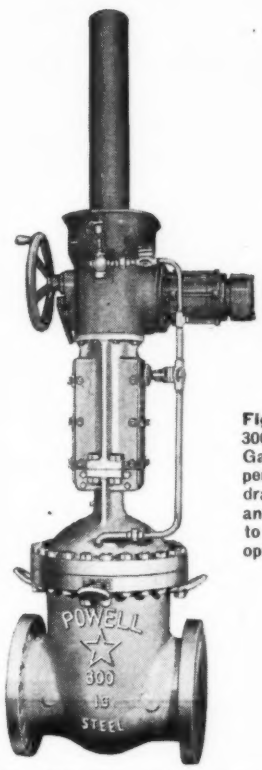

Fig. 3023—Class 300-pound Cast Alloy Steel Gate Valve with automatic steam sealing mechanism. Has explosion proof electric motor operator.

Fig. 375 — 200 - pound Bronze Gate Valve with renewable "Powellium" nickel-bronze disc.

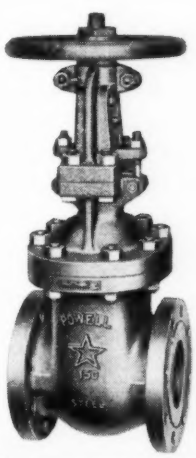

Fig. 1503—Class 150-pound Cast Steel O.S.& Y. Gate Valve.

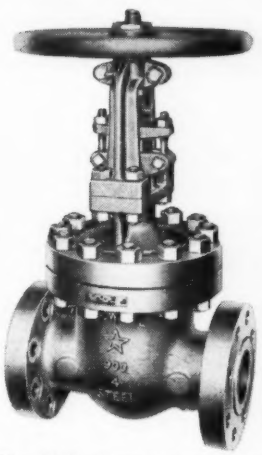

Fig. 9003—Class 900-pound Cast Steel O.S.& Y. Gate Valve.

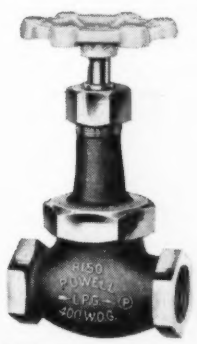

Fig. 8150—Bronze L.P.G. Globe Valve with special composition disc. Write for descriptive circular 8-48B.

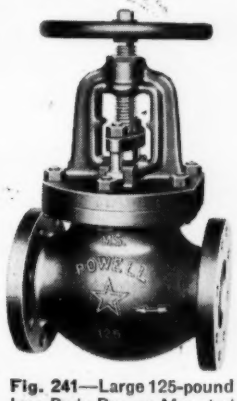

Fig. 241—Large 125-pound Iron Body Bronze Mounted O.S.& Y. Globe Valve.

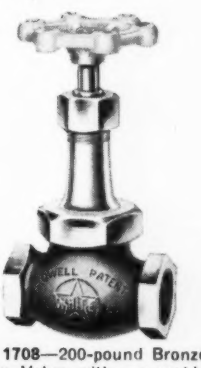

Fig. 1708—200-pound Bronze Globe Valve with renewable stainless steel seat and regrindable, renewable "Powellium" nickel-bronze disc.

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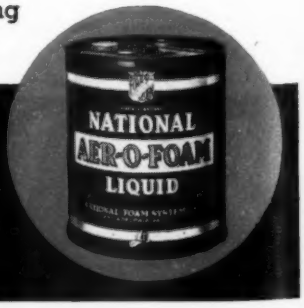
14 SECONDS..
FIRE UNDER CONTROL

Every batch of National AER-O-FOAM is "Fire-Tested."

Fire-Tested and performance-proved AER-O-FOAM gives positive, unfailing protection to your production facilities, refineries and bulk plants. Positive, quick action that can bring flammable liquid fires under control in as short a time as 14 seconds.

AER-O-FOAM acts quickly to form a thick, tough, lasting airtight blanket of foam that snuffs out flames . . . insulates threatened areas and prevents flashbacks. AER-O-FOAM is non-corrosive—is easily washed away with hose stream, or after drying can be readily brushed off machinery, walls and floors.

For protection that must be positive rely on FIRE-TESTED National AER-O-FOAM. For complete fire fighting equipment and engineering assistance, call on National Foam Engineers.



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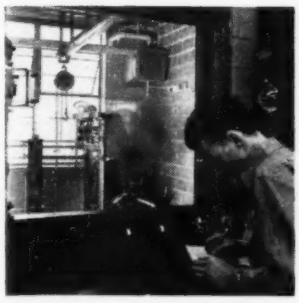

Monsanto's new Petroleum Chemicals Testing Laboratory provides in one central location (St. Louis) complete testing facilities for important phases of lubricant evaluation. Pictured here is the central control hall, from which tests in surrounding engine cells may be controlled and observed, free from distracting noises.

VISCOSITY INDEX IMPROVER

SANTODEX

GIVES YOU	Higher viscosity indices Doubled grading
GIVES YOUR CUSTOMER	Improved starting ease Increased engine protection Reduced oil consumption

The better performance contributed by Santodex—Monsanto's VI improver—offers refiners and compounders important sales advantages that merit thorough investigation by anyone interested in increased profits resulting from improved products.

In addition, Monsanto offers refiners and compounders a greatly expanded technical service through its newly enlarged Petroleum Chemicals Testing Laboratory. Not only is it possible to "custom blend" base oil stocks for improved viscosity index—Monsanto research facilities are also developing new and better pour point depressants, gear lube additives, motor oil inhibitors and detergents (including special blends). To learn how Monsanto can improve your petroleum products, write to MONSANTO CHEMICAL COMPANY, Petroleum Chemicals Department, 1700 South Second Street, St. Louis 4, Missouri. To obtain specific information on Santodex, simply return the coupon.

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CHEMICALS for PLASTICS

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Petroleum Chemicals Department
1700 South Second Street, St. Louis 4, Missouri
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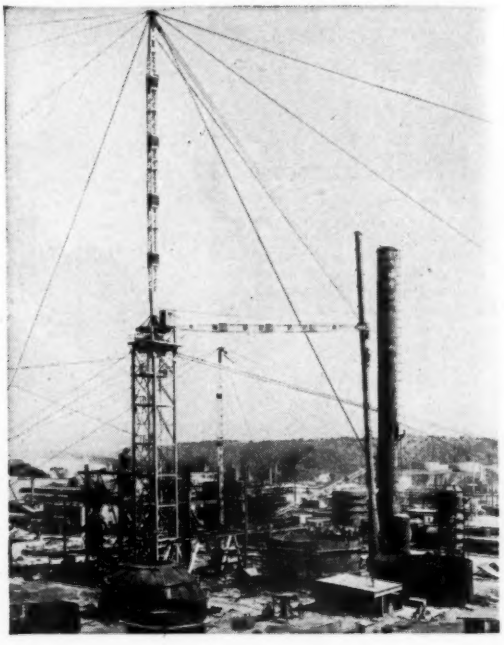

THE "master" type of contract, concentrating all work done at any one refinery site in one contractor's hands, reduces overall labor costs in at least three specific ways.

First, it eliminates competition for available local craft labor between several contractors all working for the same refiner. "Made" work, to hold labor for one particular contractor against the arrival of material, or pending the completion of a previous craft step at any one unit, is completely eliminated . . . and the extra costs duplicated by each additional contractor in the picture can thus be saved.

Second, with all labor employed by *one* contractor it makes possible the immediate establishment of a *uniform labor policy* throughout the entire project. Under centralized control not only is the *quality* of the work improved but also working hours can be arranged, within Union rules, to the best advantage of the refiner—without resort to special bonus arrangements, either in hourly rates or authorized overtime. Such bonus arrangements quite frequently add as much as 15% to normal labor costs. Hence, the resulting savings in overall costs are a major consideration.

Third, with centralized control of labor, crafts can be moved from day to day *at will* about the entire site to the particular job *where they can be utilized to greatest advantage* . . . or to that section of the entire project *where materials are immediately available* . . . or to the particular job that will serve best to advance the project as a whole. This affects not only the initial cost of the project, but also contributes to an earlier "on stream" date and thus to long-term refinery earnings.

At-the-site labor, on major refinery modernization projects, averages about ⅓ of the total cost of the project. If the advantages detailed in this short outline were to account for only a small increase in the efficiency of labor employment on the site, a refiner could look forward to sizable dollar savings. But the "master" contract type of operation offers many *other* advantages in the field construction phase—more economical use of tools and equipment, reduction of temporary facilities, savings in field administration and accounting—which when grouped with the indicated labor savings, emphasize the advisability of *centralized responsibility* in the field.

G. F. BAYES

Director of Construction

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TOMORROW

. . . IN PETROLEUM TECHNOLOGY

Current technological and economic developments discussed here in the light of their future bearing on petroleum refining operations include:

- **Compendium on energy sources presented at API meeting.**
- **Tariff Commission releases data on petrochemicals.**
- **"Automobile Facts" gives new slant on car life.**
- **Petroleum coke demand is exceeding the supply.**

Exhaustive Compendium Of Our Energy Sources

IN THESE DAYS of conflicting testimony on the size and sufficiency of our "fossil fuel" reserves and on measures to supplement them in various ways, it is noteworthy to come upon a considered projection into the far-distant future of present knowledge on energy sources. Such a survey was presented last month at the API meeting in Chicago by Eugene Ayres, chief chemist of the Gulf Research & Development Co.(1)

This paper is so detailed and lengthy that its widespread reproduction *in toto* is likely to be limited, an unfortunate consequence of the breadth of coverage. Turning to those "continuous" energy supplies which must satisfy our needs when and as our "unrenewable" sources of energy become exhausted, Ayres lists, "in order of magnitude," solar energy, waterfalls, the earth's heat, vegetation, tropical waters, tides, atmospheric electricity, wind, and the heat pump. As mentioned above, the discussion is based on extrapolation of present knowledge, and much of the data presented, while apparently soundly based, takes on a Jules Verne-science-fiction air, but the vast potentialities shown should be comforting to those who fear a cold and unpopulated world, many eons hence.

As Ayres points out, we are at present relying almost exclusively upon exhaustible sources of energy—fossil fuels such as coal, petroleum, natural gas, and, potentially, shale oil and the like. Moreover, even "atomic energy" is not inexhaustible—"our supplies of fissionable elements are quite as definitely limited as our supplies of fossil fuels." Much interesting data are presented on reserves, trends of fuel consumption, efficiency of energy application, etc. Inevitably, certain assumptions had to be made which will appear controversial to some, but the over-all picture presented is fascinating—and is important.

Even if estimates of fossil fuel reserves are wrong; even if the eventual solution of the problem is postponed a generation or two, Ayres points out that the present era cannot be looked upon as one in which energy has been uniquely abundant. "Instead, there is every reason to expect that succeeding eras will provide still greater abundance of energy from our constant sources. In the meantime, there is much work to be done"—on new systems of energy production and consumption, conservation of present sources, etc. As Ayres points out, conservation *is* important for there is nothing known at present which indicates that energy from constant sources will not cost more than that from our exhaustible supplies.

"Fortunately for the nation, the petroleum industry—with its philosophy of bigness in its operations, its developments, and its thinking, and with its unmatched versatility of scientific achievement—is prepared to accept the challenge with all that this entails of opportunity and responsibility." It may seem presumptuous thus to look 300 or 400 years into the future, and future generations may well laugh at this effort, but action and positive thought are never unimportant, and Ayres' paper is therefore a significant contribution.

(1) Eugene Ayres, *Major Sources of Energy*. Paper presented before the Division of Refining, American Petroleum Institute, Chicago, November 9, 1948.

New Data are Available On Petrochemical Output

AS ALL WITHIN the petroleum and chemical industries are aware, the production of organic chemicals from petroleum continues to increase in volume and diversity. This is not clearly shown by a recent report for 1947, released by the U. S. Tariff Commission,(2) since this actually shows that "in 1947, output of these products (crude products from petroleum) declined to 3.1 billion from 3.5 billion pounds produced in 1946," but even this decrease "was due mainly to a reduction in the manufacture of butadiene for synthetic rubber to 696,000,000 pounds from the 1 billion reported for 1946," and it may safely be assumed that no real leveling off is yet in sight.

In more detail, the above-mentioned report showed a total 1947 production of 638,936,000 pounds of (crude) aromatics and naphthenes (an increase of some 34,000,000 pounds over the 1946 production) and 2,491,497,000 pounds of aliphatic hydrocarbons. On a production and unit-value-of-sales basis, basic details were as shown in Table 1.

On a gallon basis, it is interesting to note that the toluene produced from petroleum in 1947 amounted to 27,378,000 gallons of the 60,740,000 produced from all sources; that petroleum-derived xylenes amounted to 33,091,000 gallons of the total production of 41,353,000; and that petroleum-produced cresylic acids undoubtedly accounted for a large fraction of the 35,808,000 pounds produced from petroleum and coal tar combined.

Space does not permit detailed analysis of statistics for specific petro-chemicals, although it is highly pertinent to note that production of plastic materials (not including cellulose materials) rose 22% in 1947 to 1.3 billion pounds; that production of plasticizers rose 29% to 148,000,000 pounds; that production of synthetic surface-active agents (detergents, etc.) rose 20% to 291,000,000 pounds; and that production of miscellaneous chemicals rose 21.2% to 10.1 billion pounds. In the last category, notable production increases occurred for numerous petrochemicals

(2) Anon., *Synthetic Organic Chemicals, United States Production and Sales* 1947, Preliminary, United States Tariff Commission, Washington, 1948. 56 pages.

TABLE 1—1947 U. S. Production and Sales Value of Crude Products from Petroleum and Natural Gas for Chemical Conversion

	Production (1,000 lb.)	Unit Value of Sales ($/lb.)
Aromatics and Naphthenes (total)	638,936	0.02
Cresylic acid, crude	(1)	(1)
Naphthenic acids	29,830	0.06
Toluene, all grades	198,214	0.02
Xylene, all grades	238,583	0.03
All other aromatics	172,309	0.02
Aliphatic Hydrocarbons (total)	2,491,497	0.04
C_2 hydrocarbons: Ethylene	341,959	0.05
C_3 hydrocarbons: Propane and propylene	463,627	0.01
C_4 hydrocarbons, total	1,458,820	0.05
1,3-Butadiene, rubber grade	696,388	0.08
1-Butene and 2-butene fraction	490,205	0.02
All other	272,227	0.04
C_5 hydrocarbons	12,750	0.11
All other aliphatic hydrocarbons	214,341	0.01

(1) Statistics included in "all other aromatics."

such as formaldehyde, halogenated hydrocarbons, isopropyl alcohol, acetic acid, and acetic anhydride.

Government bureaus are much maligned, but few can deny that they serve in a material manner when they compile and release statistics in fields in which guesses would otherwise have to be substituted. This Tariff Commission series on synthetic organic chemicals is an excellent example of a real service contribution.

"Automobile Facts, Figures" Gives New Slant on Car Age

WHILE ANNUAL STATISTICAL compendia of the type of "Automobile Facts and Figures"(3) are, almost of necessity, usually issued nearly a year after the latest statistics included, they are still of considerable value in indicating trends and in presenting an over-all picture of the industry covered. In the case of the automotive industry, most of the statistics included have already been publicized, but their significance has in some cases escaped attention.

For example, it is common knowledge that the automotive industry has been producing automobiles, trucks, and buses at record or near-record levels for nearly three years, and many still are looking for the "bubble" of car demand to be pricked in the near future by the sharp edge of a saturated market. However, those who hold this belief—undoubtedly supported by the dampening effect of rising car prices—may not have considered the fact that the average age of cars in use on July 1, 1947, was 8.1 years, compared with 5.6 years on July 1, 1941, and that 24,272,000 of the 27,285,000 cars in use on the former date were produced before the war.

Moreover, a survey made in April, 1947, showed that the average vehicle then on the road had been driven 58,000 miles—that their mileage age was greater than in 1946, when the average car speedometer reading was 55,000 miles. Actual figures were as follows:

Year-Model	Miles Driven
1934 and earlier	84,000
1935-36	76,000
1937-38	73,000
1939-40	65,000
1941-42	57,000
1946-47	11,500

While most cars over ten years old have thus been driven more than 70,000 miles, there are some statistics which are not so discouraging to the petroleum industry which, naturally, is interested in continued high gasoline consumption. Vehicle lifetime mileage has tripled in the last 20 years. The average life of vehicles scrapped in 1946 was 12.75 years, with an accumulated average lifetime mileage of 88,550 miles. These figures may be compared with 10.2 years and 81,350 miles per vehicle in 1941; 8.3 years and 58,000 miles in 1935; and 6.5 years and 25,750 miles in 1925.

Moreover, as mentioned earlier, these are only the latest published statistics, not the latest existing ones. As a guess, it seems probable that record production has dropped the average car age to about 7.5 years and that average car mileage has not increased during the last year. If car production can surmount raw material and labor difficulties and continue at record levels for at least two or three more years, and if a recession does not sap demand by draining off buying power, it would appear that the crisis is past. The record gasoline demand during the past two years, incidentally, is evidence not only of the record number of vehicles on the road, but also of their record per capita consumption —attributable at least in part to the lessened mechanical efficiency of "old age."

It should not be thought that this report(3) is by any means devoted exclusively to the statistics just quoted. Instead, it is a well rounded index to car production, exports, replacement parts, registration, types of use, prices, taxes, gasoline consumption, roads, etc. Its annual publication serves a most worthy purpose.

Petroleum Coke Demand Is Exceeding the Supply

PETROLEUM COKE, once produced as only the unavoidable by-product of direct fired shell stills and early thermal cracking units, is now produced in large quantities in delayed coking units designed to produce maximum yields of gasoline and of by-product distillate oils and petroleum coke, rather than by-product heavy fuel oils. According to a recent survey of the fields of industrial carbon,(4) there are 13 delayed coking installations in operation or under construction in this country, with a combined annual output of about 800,000 tons of petroleum coke (reduced crude charging capacity, about 40,000,000 bbl. annually), and "it is reported that new coking facilities are planned in the St. Louis and Toledo areas and would add to petroleum coke production by about 100,000 to 300,000 tons per year."

Some interesting facts are presented in this survey. It is pointed out that most of the petroleum coke production takes place in non-coastal areas, where the markets for heavy fuel oil are not as good as in the coastal regions (one big plant, however, was recently constructed in California). Supplies of petroleum coke are said to be inadequate for industrial uses, despite record production; industrial uses "have increased considerably relative to strictly fuel uses."

The situation is expected to get worse (from the consumers' point of view). Crude oil refining (according to this source) is expected "to level off because of dwindling supplies." Secondly, "the amount of petroleum coke produced per barrel of oil refined is trending down. . . . This trend will no doubt continue," since most refineries are now installing catalytic cracking units and "non-coking type auxiliary units to make feed stocks for catalytic cracking." However, "a substantial increase in the price of petroleum coke could alter this tendency."

As regards present operations, petroleum coke production is maximized by the high demand for gasoline and distillate fuel oils. Even this fact does not alter the situation, however, because industrial demands are rising and an increasing fraction of the petroleum coke produced is not of suitable quality. "For most industrial uses, low sulfur and low ash cokes are needed." However, the increasing use of high sulfur crudes is yielding high sulfur cokes suitable chiefly as fuels. In addition, the use of various chemicals in the refining processes has served to raise the ash content of some cokes "from under 1% to as much as 9% or higher," making them unacceptable for many uses.

"For such large scale uses as aluminum electrodes, anodes, refractory shapes, etc., demand for petroleum coke has been increasing." Prices have risen considerably since 1941; green coke now is reported to sell for $15-$20 per ton, f.o.b. refinery (compared to $5-$10 per ton in 1941), while "calcined petroleum coke is approaching the $40-$50 per ton level in the Great Lakes area, having risen from $20-$30 per ton."

This survey of industrial carbon touches in detail on carbons produced from other raw materials—coal, natural gas, and wood, but space does not permit discussion of these carbons here. For the next few years, at least, "users of industrial carbon will still have to rely on petroleum coke and charcoal for their raw materials for various processes and products," although much-needed research on production from selected coals, coal tars, petroleum residues, and shale oil may eventually supply the answers to the problems occasioned by the growing shortage of industrial carbon.

(3) Anon., *Automobile Facts and Figures*, 28th Edition, Automobile Manufacturers Association, Detroit, 1948. 80 pages.

(4) Raymond B. Ladoo and C. A. Stokes, "Industrial Carbon," *Chemical Industries* 63, No. 4, 609-16 (1948).

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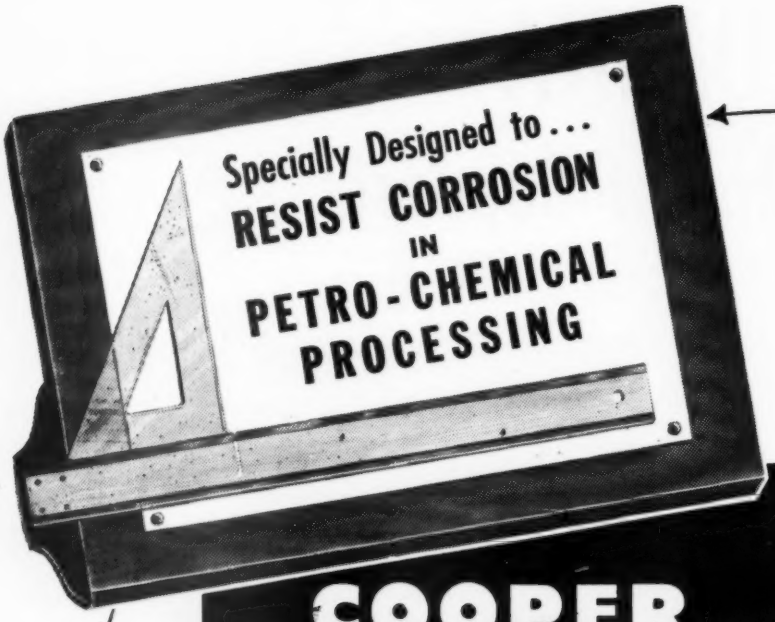

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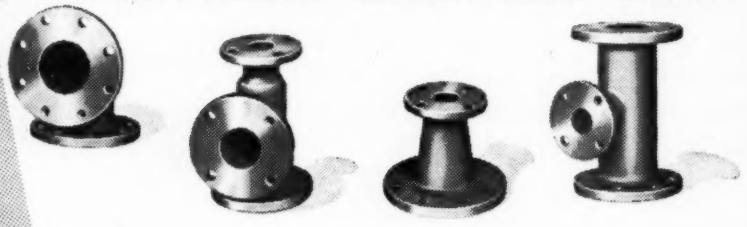

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Ⓒ 17 S	C. .07—.10%		
Ⓒ 17 SMO	C. .07—.10% Mo. 3%		
Ⓒ 17 SCB	C. .07—.10% Cb. .70%—1%	Tensile St. Yield Pt. Elong. 2 in. Red. Area Brinell Wt. per cu. in.	90,000 psi 60,000 psi 30% 35% 180 .28 lb.
Ⓒ 22	Cr. 24—28% Ni. 9 —12% C. .20—.50%		
Ⓒ 22 S	C. .10% max.	Tensile St. Yield Pt. Elong. 2 in. Red. Area Brinell Wt. per cu. in.	65,000 psi 45,000 psi 22% 25% 180 .29 lb.
Ⓒ 25-20	Cr. 24—26% Ni. 19—20% C. .20—.30%		
Ⓒ FA20	Cr. 19—21% No. 28—30% C. Max. .10% Molybdenum 3—4% Silicon 1.5% max. Cu. 4-4.5%	Tensile St. Yield Pt. Elong. 2 in. Red. Area Brinell Wt. per cu. in.	75,000 psi 45,000 psi 40% 45% 140 .29 lb.
MONEL (MM)	Ni. 67% Cu. 28% Fe. 3% Si. 1%	Tensile St. Yield Pt. Elong. 2 in. Red. Area Brinell Wt. per cu. in.	65,000 psi 33,000 psi 25% 28% 150 .32 lb.

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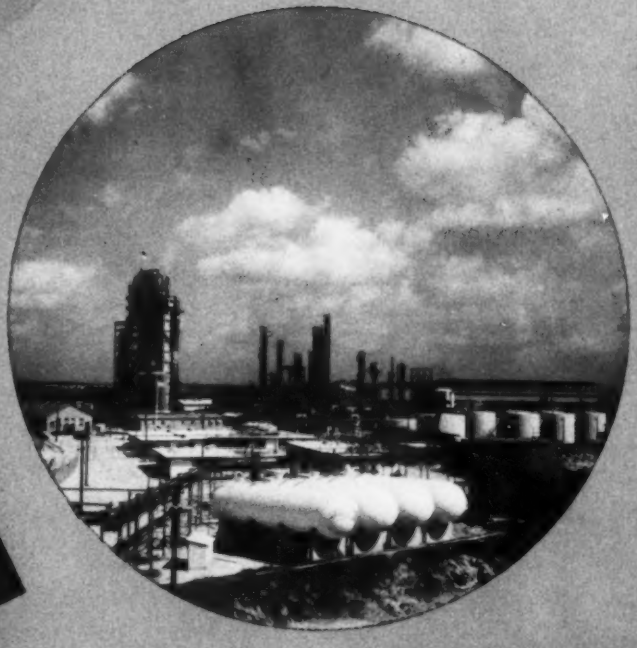

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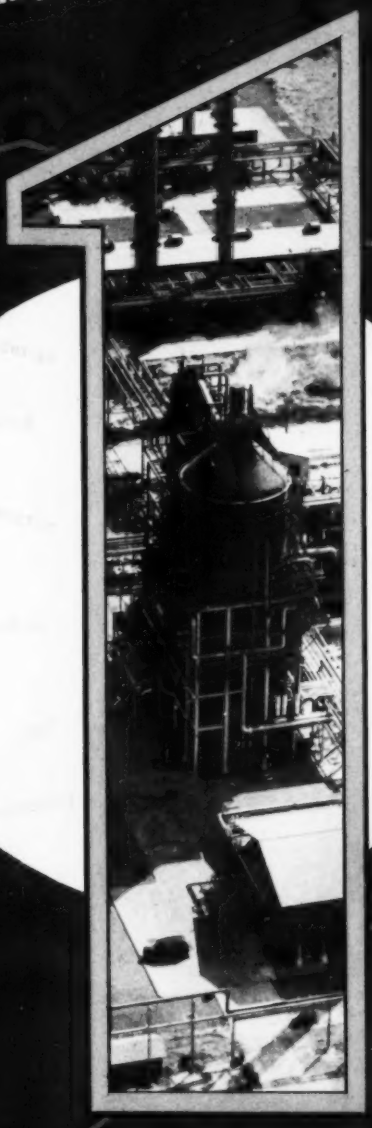

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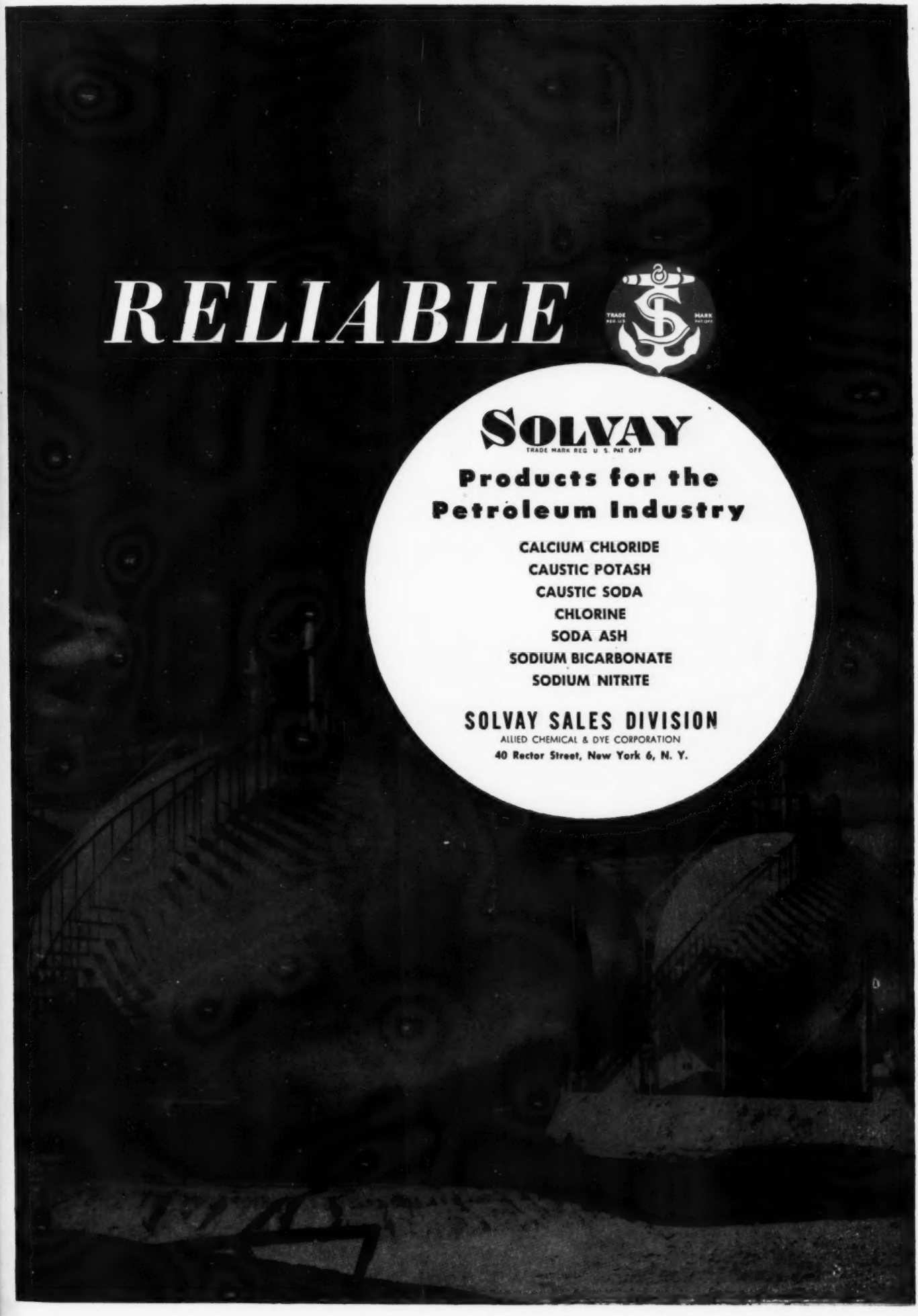
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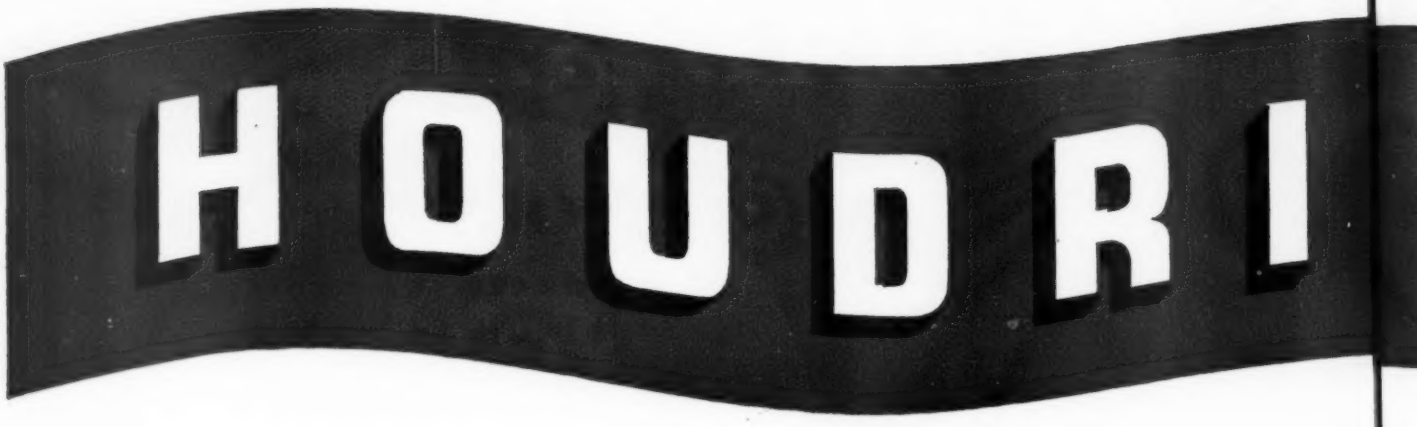

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- ✓ "Package" assembly simplifies small unit construction...
- ✓ Eight Houdriflow units already ordered by leading refiners...

Houdry Process Corporation, which pioneered catalytic cracking, now introduces its most advanced design—the new Houdriflow Process!

An evolution of the famous TCC process, Houdriflow achieves a substantial reduction in cat-cracking costs.

The new process employs a gas-lift principle for raising the catalyst. No mechanical elevator. Houdriflow utilizes catalyst to better advantage than any other existing process.

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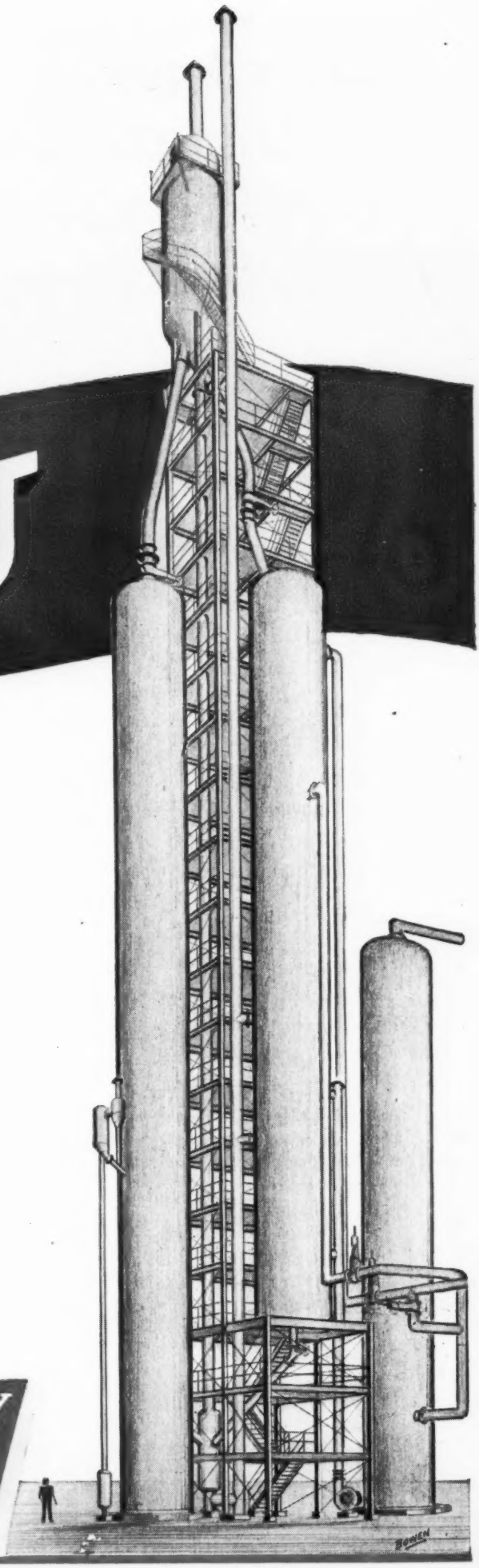

Gas-lift materially lowers construction and operating costs. Further simplification is obtained by superimposing the reactor and kiln in a single unit. Regeneration equipment is improved in design and reduced in size.

In small Houdriflow units, all the vessels can be fully assembled in the shop and shipped as a "package" to the building site, with consequent saving in erection time and cost.

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Tide Water Associated Oil Co.	Drumright, Okla.	1	6,750
Petco Corporation	Blue Island, Ill.	1	5,000

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SERVING THE PROGRESSIVE PETROLEUM INDUSTRY

Another Engineering and Construction Contract Awarded The REFINERY ENGINEERING Company

EMPIRE STATE OIL COMPANY

Thermopolis, Wyoming

Other TRECO Clients:

Treco is pleased to have been chosen to handle the design, engineering and construction of the combination 5,000 barrel topping-vacuum-vis-breaking unit for the Empire State Oil Company of Thermopolis, Wyoming. This unit will process 5,000 barrels per day of Wyoming, Hamilton Dome crude, the major portion of which is produced by the Empire State Oil Company. The company will make tractor distillate, burning oils, road oils, fuel oils and various asphalt products. The Wyoming, Hamilton Dome crude is a heavy, high sulphur type which lends itself to the production of high-quality asphalt products.

Sound Engineering, experienced personnel and ample equipment assure Treco clients of economical and speedy construction. Your enquiry will receive prompt attention.

- Arrow Petroleum Company
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- Delta Refining Company
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- Indiana Farm Bureau Co-op Ass'n
- Intra-Lake Chemical Corporation
- Leonard Refineries, Inc.
- Mercury Oil & Refining Company
- Midwest Refineries, Inc.
- Naph-Sol Refining Company
- National Refining Company
- Natural Gas Pipeline of America
- Petroleum Equipment Company
- Petroleum Specialities, Inc.
- Producers Refining Company
- Stanolind Oil & Gas Company
- Stanolind Pipeline Company
- Standard Oil of Ohio
- Sunray Oil Corporation
- The Texas Company
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- Vickers Petroleum Company
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TRECo

The REFINERY ENGINEERING Co.

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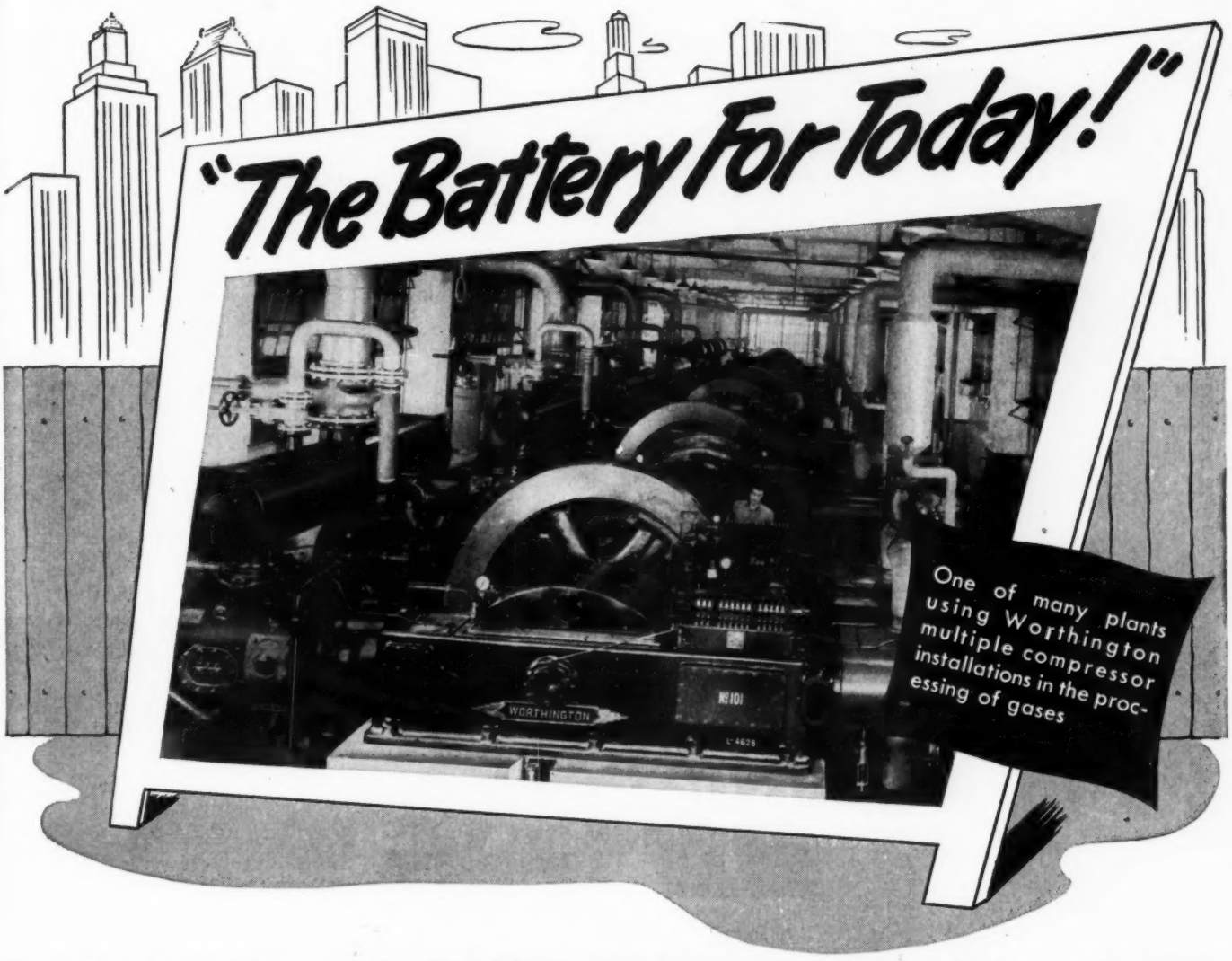

"The Battery For Today!"
WORTHINGTON
One of many plants using Worthington multiple compressor installations in the processing of gases

THAT KEEPS AIR-COSTS FROM PILING UP A SCORE

The more compressed air or gas you use, the more you can economize with Worthington Opposed Steam Driven Compressors. With over 50 years of development behind them, these rugged, tireless performers are up-to-the-minute in every last cost-saving detail. For example:

›Pressure feed lubricates each side independently, reducing outage and maintenance to a minimum . . . full accessibility to all steam and air cylinder interiors by removal of rear cylinder heads only . . . modern, trouble-free bearings for uninterrupted service . . . and Worthington Feather* Valves, most efficient ever made.

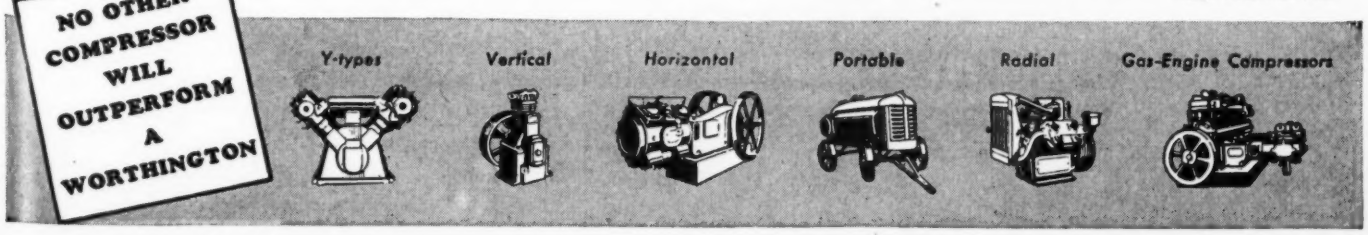
Reduced Labor and Maintenance Costs

Following the Worthington formula, these modern Compressors combine high performance efficiency with minimum maintenance requirements. Their ability to do a better job, year after year, on amazingly low operating costs is familiar proof that *there's more worth in Worthington.*

Write for Bulletin L-680-B1A. *Worthington Pump and Machinery Corporation, Compressor Division, Buffalo, New York.* K7.7

WORTHINGTON

*Reg. U. S. Pat. Off.



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Serving the CHEMICAL, POWER, PETROLEUM and GAS industries as well as providing specialized EQUIPMENT for all industries.

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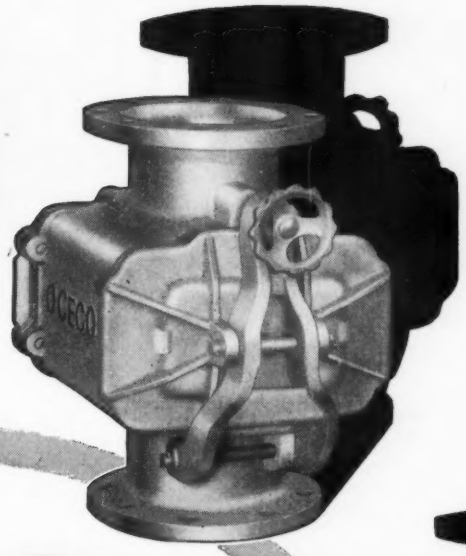
908 Grand Ave., KANSAS CITY 6, MO.—Offices in Principal Cities from Coast to Coast

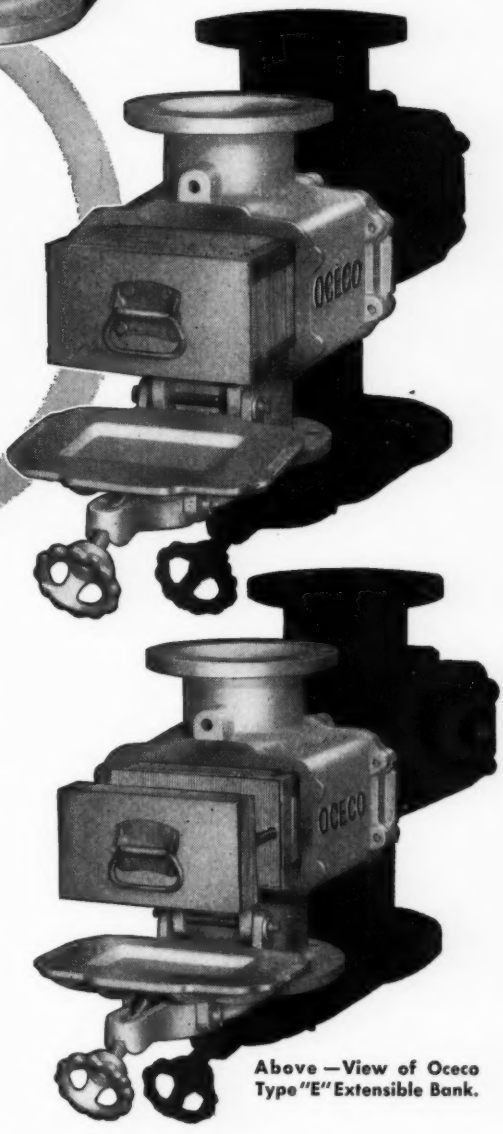
Oceco 2" Flame Arrestor Showing Screw Mounting and Side Hinge.



Oceco 6" Flame Arrestor Showing Flange Mounting and Bottom Hinge.

Below—View of Oceco Type "F" Fixed Bank.

OCECO
FLAME ARRESTORS
for outstanding performance



Above—View of Oceco Type "E" Extensible Bank.

● Oceco Flame Arrestors—have won outstanding recognition throughout the entire petroleum industry. They combine the desired flame stoppage and explosion prevention with minimum pressure drop.

Housings and covers are semi-steel castings, with high melting point and consequently provide substantial heat resistance and protection to the flame arrestor "bank", even when subjected to the intense heat of sustained fire.

The "banks" consist of flat and corrugated sheets of high purity, corrosion resisting aluminum arranged alternately to form vertical straight through passages. They are of sufficient depth, top to bottom, to resist "burning through",—and the straight through passages minimize depositing of moisture and clogging; —and simplify inspection.

Furnished in 2" and 3" sizes for screw mounting and 4", 6", 8" and 10" sizes for flange mounting; —with either type "F" fixed banks, or type "E" extensible banks, that permit the plates to be separated for individual cleaning. Send for Bulletin No. 471. It gives full details.

OCECO

Division of THE JOHNSTON & JENNINGS CO.

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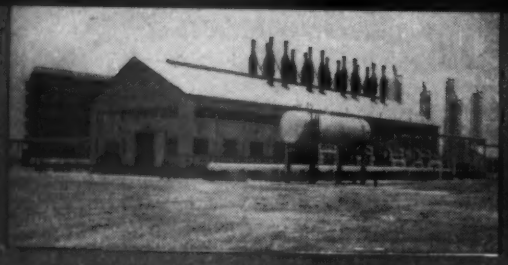
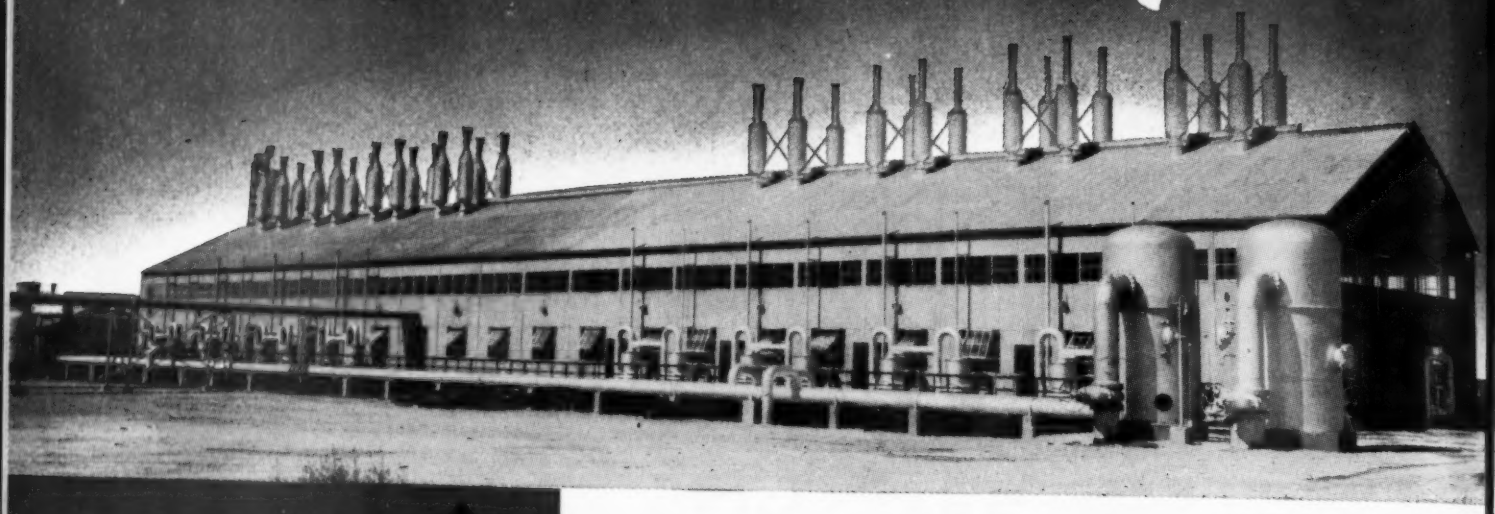
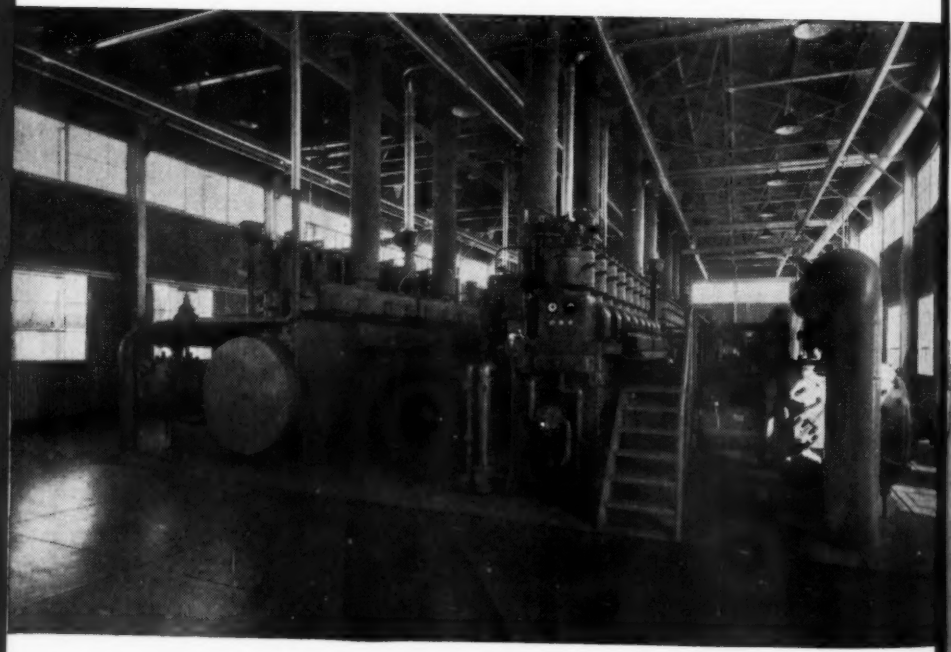
Shell Repeats



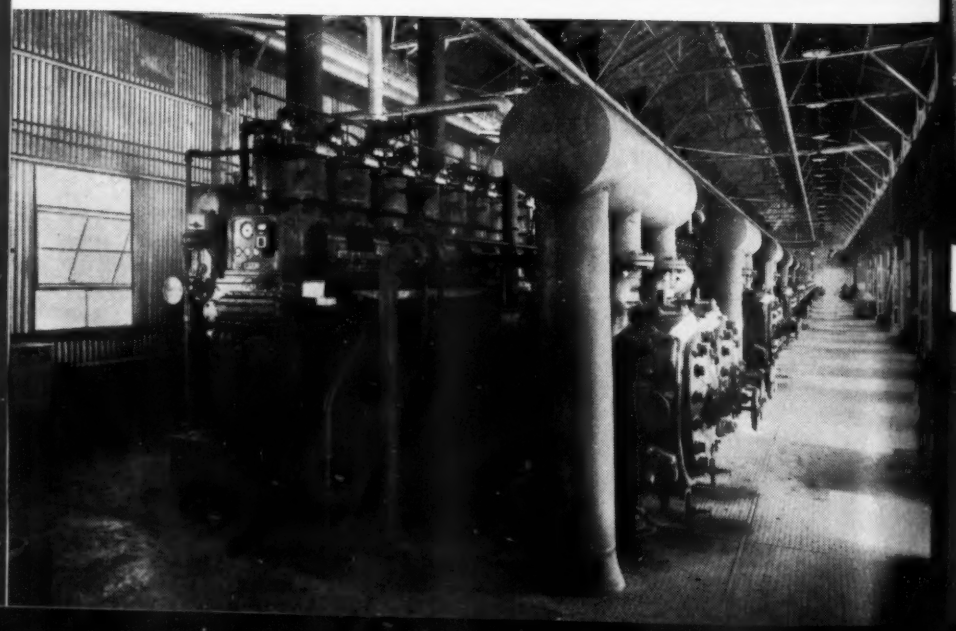
Original compressor installation at Wasson No. 2 Plant consisted of eight Clark 800 BHP Right Angles.



Wasson No. 2 Plant was expanded and eight more Clark Compressors were added.



This photo shows one of the two similar installations of Clark Right Angles at Wasson No. 2 Plant.



Eleven Clark units are visible in this interior view of the TXL Plant.

with Clark Compressors

for New TXL and WASSON No. 2 Gasoline Absorption Plants

The Shell Oil Company's new TXL plant in Ector County, Texas, duplicates the operating conditions of Shell's Wasson No. 1 and No. 2 gasoline absorption plants in Yoakum County, Texas.

In these modern plants, 34,400 brake horsepower of Clark Right Angle Gas Engine Driven Compressors take the gas in from the field at pressures between atmosphere and 7 psig and compress it in two stages to a final discharge pressure of 205 psig. At this final pressure, the hydrocarbon gas is processed in highly efficient absorber units where the gasoline is extracted.

CLARK BROS. CO., INC. • OLEAN, NEW YORK

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Shell's new TXL Plant in Ector County, Texas, showing compressor house in foreground containing eleven 800 BHP Right An

CLARK

ONE OF THE DRESSER INDUSTRIES

SETS THE PACE IN COMPRESSOR PROGRESS

DU PONT ADDITIVES... add the QUALITIES

You Want to Your Fuels and Lubricants

This partial list of Du Pont fuel and lubricating oil additives is indicative of the results of a continuing program to produce new and better additives. Each has been produced to meet a specific need . . . to improve the desirable properties of petroleum products, or to inhibit deterioration caused by oxidation, polymerization, or metal entrainment. Write for complete information. E. I. du Pont de Nemours & Company, (Inc.), Petroleum Chemicals Division, Wilmington 98, Delaware.

NAME	Description	Use
Du Pont Gasoline Antioxidant No. 5	A solution of normal butyl-para-aminophenol in alcohols.	For improving the storage stability of gasoline.
Du Pont Gasoline Antioxidant No. 6	A solution of isobutyl-para-aminophenol in alcohols.	For improving the storage stability of gasoline.
Du Pont Gasoline Antioxidant No. 22	A commercial grade of N:N'-disecondary-butyl-para-phenylenediamine.	For improving the storage stability of gasoline.
Gasoline Dyes	Du Pont Oil Orange Du Pont Oil Red Du Pont Oil Yellow N Du Pont Oil Blue	For color identification of gasolines.
Du Pont Metal Deactivator	An 80% solution of N:N'-disalicylidene-1:2 diamino-propane in xylene.	To improve the storage stability of petrolum distillates containing dissolved copper.
Du Pont Rust Preventive No. 1	A viscous, reddish-brown clear liquid, readily soluble in mineral oil at room temperatures.	For use in petroleum bases to impart non-staining rust preventing properties.
"Ortholeum" 153	Fluorescent green liquid.	For use in motor oils and other lubricants to improve wear characteristics under conditions of boundary lubrication.
"Ortholeum" 202	A sulfurized terpene containing approximately 34% sulfur of controlled activity.	For use as a bearing corrosion inhibitor in detergent type oils. Sulfur activity also suggests usefulness as additive for cutting oils and hypoid lubricants.
Du Pont Phenyl-alpha-naphthylamine	Crystalline solid.	Oxidation inhibitor for various petroleum products.
Du Pont Phenyl-beta-naphthylamine	Powder.	Oxidation inhibitor for various petroleum products.
Du Pont Tributyl Phosphite	Water-white liquid.	For use in oils as a mild antioxidant and as a wear reducing agent.
Du Pont Tetraethyl Lead Compound—Motor Mix	Yellow liquid antiknock compound the principal component of which is tetraethyl lead.	For use as an antiknock agent in motor gasolines.
Du Pont Tetraethyl Lead Compound—Aviation Mix	A blue liquid antiknock compound the principal component of which is tetraethyl lead.	For use as antiknock agent in aviation gasolines.
Du Pont Fuel Oil Stabilizer No. 1	A blend comprising an antioxidant and metal deactivators in isopropanol.	Added to cracked furnace and diesel oils to improve storage stability.

- *Tetraethyl Lead Compounds*
- *Gasoline Oxidation Inhibitors*
- *Gasoline Dyes*
- *Lubricating Oil Additives*
- *Fuel Oil Additives*

PETROLEUM CHEMICALS

DU PONT
REG. U.S. PAT. OFF.

BETTER THINGS FOR BETTER LIVING
...THROUGH CHEMISTRY

How you can...

1. lengthen on-stream time
2. reduce maintenance costs
3. step up production

...by *controlling* corrosion

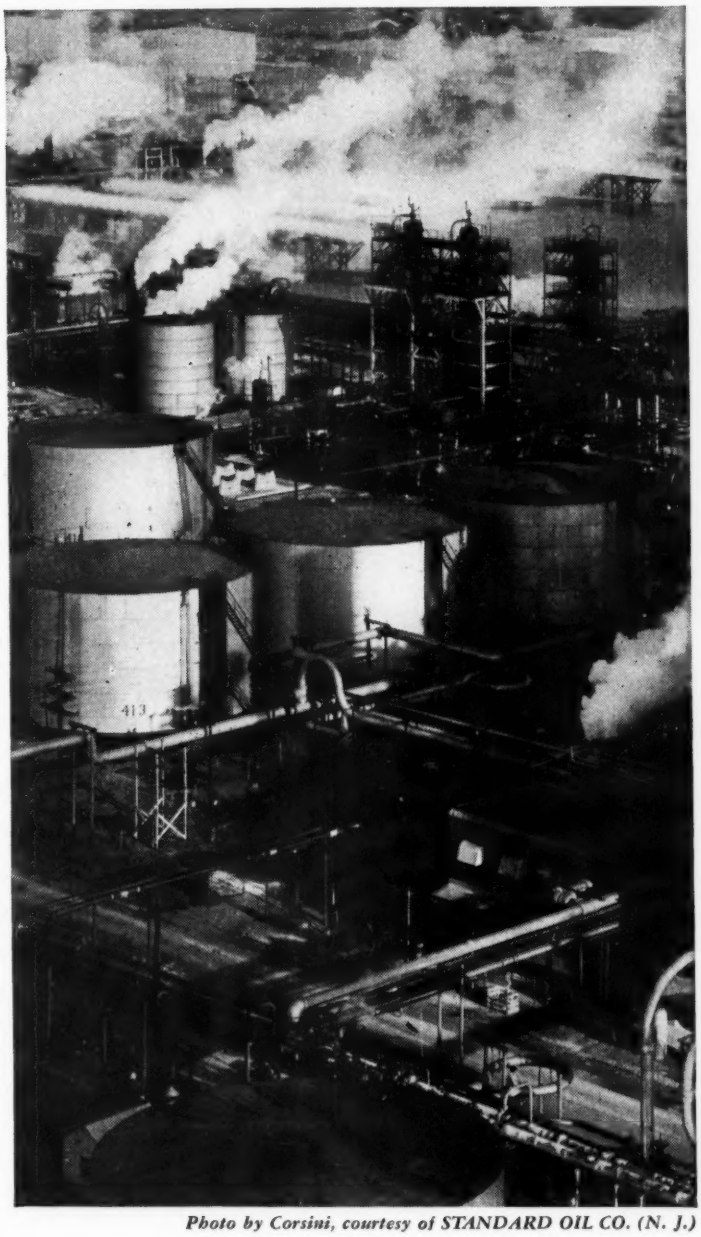


Photo by Corsini, courtesy of STANDARD OIL CO. (N. J.)

Wherever severely corrosive conditions result in expense, delay and shut-down, there's a good chance that switching to Nickel Alloy equipment will help you.

Take the experience of a prominent West Coast refinery. They were having trouble with the gasoline condenser of a light crude distillation unit. Tube bundles lasted only 2 to 8 months. Average service life was 5 months.

Finally they installed a Monel* tube bundle. Four years later, they reported the Monel bundle was still in use—*and showed no evidence of leakage.*

Performance like this isn't unusual. And it isn't confined to heat exchanger applications. Nickel and high-Nickel alloys like Monel, "K"* Monel and Inconel* are widely used for pumps, piping, valves, regenerator boilers, preheaters and filters, to mention only a few applications in a long list.

Many Refinery Uses

Monel, for example, withstands a wide range of corrosives. Among them are:

... hydrogen sulfide	... ammonia
... hydrochloric acid	... oil, wax and solvent mix
... sodium hydroxide	... impure or brackish waters

Monel also resists hydrofluoric acid in HF alkylation; it serves dependably under high-temperature, high-pressure conditions in feed water heaters, and resists attack in condensers for chlorinated solvents and furfural. Its tensile strength is 75,000-85,000 psi.

Heat-treatable "K" Monel

All the good properties of Monel—and more besides—are present in heat-treatable "K" Monel. Through heat treating, it gains *extra* strength and hardness without sacrificing any of its corrosion resistance.

How to get help

If you have a problem involving corrosion, don't experiment. Trial and error methods take time ... cost money—don't always get results. Let INCO help you!

For over 20 years, INCO's Corrosion Engineering Section has been studying all forms of corrosion. They've summarized and compiled information from more than 40,000 plant tests, laboratory studies and technical papers into a huge *Corrosion Data File.*

You are invited to share the things we've learned. Regardless of what your problem is, regardless of the metals or materials concerned, if your problem involves corrosion—*ask our Corrosion Section to help you.* If the answer is in the Corrosion Data File, you'll get a prompt, complete and impartial report.

Of course, it can happen that even among the 40,000 reports there isn't one that covers *your* problem. In that case, INCO's Corrosion Section will be glad to cooperate with your engineers in arranging tests either in the laboratory or in your own plant. There's no fee, no obligation. Write "INCO Corrosion Engineering Section"—at the address below—today.

THE INTERNATIONAL NICKEL COMPANY, INC.
67 Wall Street, New York 5, N. Y.

*Reg. U. S. Pat. Off.

EMBLEM OF SERVICE
NICKEL INCO ALLOYS
TRADE MARK

Your PARTNERS in PROGRESS

The HORTON Double-Deck Floating Roof

This 96,000-bbl. tank, 120 ft. in diam. by 48 ft. high, equipped with a Horton Double-Deck Floating Roof, is located at the Sinclair Oil Company's East Chicago, Indiana, refinery. A close-up view of the roof on this tank is reproduced below. Tanks with Horton Double Deck Floating Roofs used extensively for crude oil and gasoline storage.

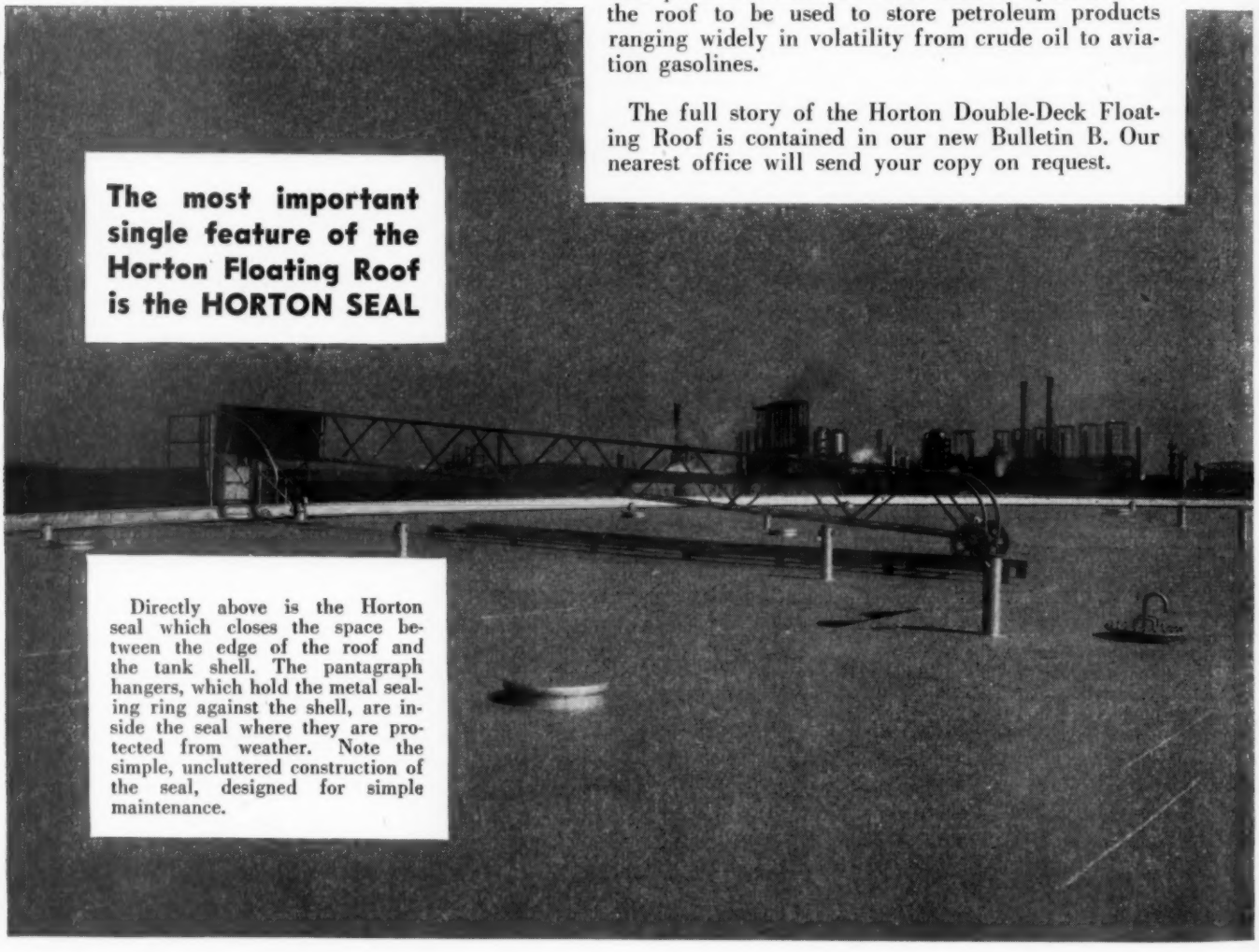
Double-Deck construction increases efficiency of roof

THE Horton Double-Deck Floating Roof works for economical storage in four ways: it prevents evaporation losses; it protects the quality of the liquid stored; it reduces corrosion on the inner surfaces of the tank and on its own bottom deck; and it reduces the danger of costly fire damage.

The double-deck construction of the Horton Floating Roof provides an insulating dead-air-space above the surface of the liquid. This insulation reduces the amount of heat transfer from the atmosphere to the liquid and serves to minimize "boiling" losses. This protective insulation also makes it possible for the roof to be used to store petroleum products ranging widely in volatility from crude oil to aviation gasolines.

The full story of the Horton Double-Deck Floating Roof is contained in our new Bulletin B. Our nearest office will send your copy on request.

The most important single feature of the Horton Floating Roof is the HORTON SEAL



Directly above is the Horton seal which closes the space between the edge of the roof and the tank shell. The pantagraph hangers, which hold the metal sealing ring against the shell, are inside the seal where they are protected from weather. Note the simple, uncluttered construction of the seal, designed for simple maintenance.

CHICAGO BRIDGE & IRON COMPANY

Plants in BIRMINGHAM, CHICAGO, SALT LAKE CITY and GREENVILLE, PENNSYLVANIA

Atlanta 3 .....2103 Healey Building
Birmingham 1 .....1527 North Fiftieth Street
Boston 10.....1029-201 Devonshire Street
Chicago 4 .....2114 McCormick Building
Cleveland 15 .....2215 Guildhall Building
Detroit 26 .....1532 Lafayette Building
Houston 2 ....2130 National Standard Building
Havana .....402 Abreu Building
Los Angeles 14 .....1426 Wm. Fox Building
New York 6.....3310-165 Broadway Building
Philadelphia 3 ..1630-1700 Walnut St. Building
Salt Lake City 1 1530 First Security Bk. Building
San Francisco 11 ..1208-22 Battery St. Building
Seattle 1 .....1330 Stuart Building
Tulsa 3 .....1620 Hunt Building

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up to 6 Records in 6 Different Colors with 1 Measuring System . . . recording at 6-second intervals!

THE NEW MULTI-RECORD DYNALOG*

Employing only one measuring system, the new Foxboro Multi-Record Dynalog gives up to 6 clean-cut records, in as many different colors, on one convenient *round* chart! The unique, foolproof switching arrangement provides recordings in sequence every 6 seconds—so close that the record of each measurement appears as a continuous line. And the record colors *positively* will not run together.

Like all Dynalog Electronic Instruments, balancing from any measurement point is entirely *stepless* and continuous. And the combination of accuracy, sensitivity, and speed is unequalled by any other instrument.

NOW . . . Wherever you have several temperatures or other process variables to record, depend on the new Multi-Record Dynalog to simplify and standardize your operations. Get all the facts. Write for Bulletin 428. **The Foxboro Company, 246 Neponset Ave., Foxboro, Mass., U. S. A.**

**Reg. U. S. Pat. Off.*

Another FOXBORO FIRST

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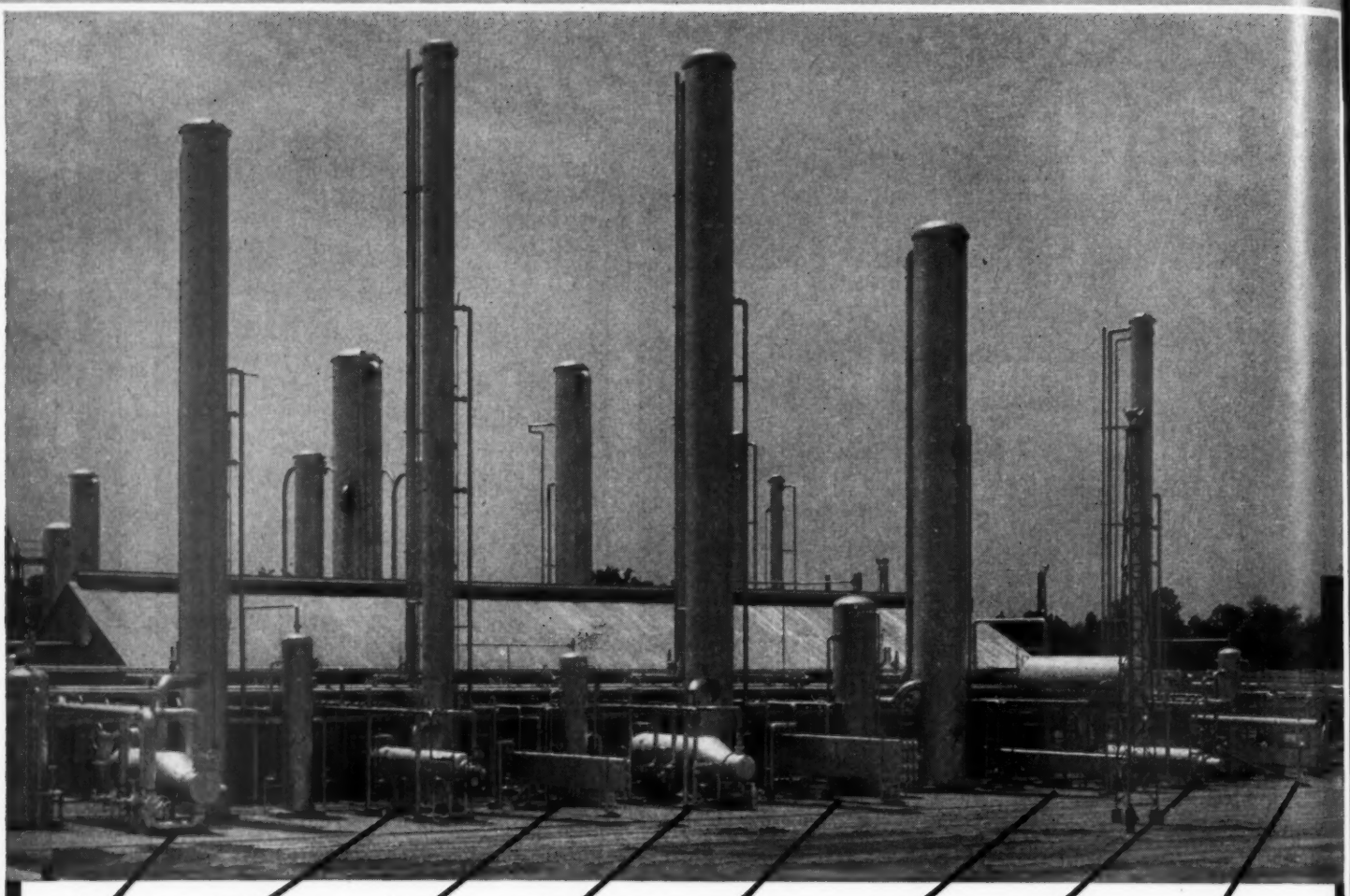


OIL HEATED KEROSENE FRACTIONATOR REBOILER

DE-PROPANIZER REBOILER

TWIN G-FIN DE-PROPANIZER EXCHANGER

DE-BUTANIZER REBOILER

TWIN G-FIN SECTION DE-BUTANIZER BOTTOMS EXCHANGER

TWIN G-FIN SECTION FRACTIONATOR FEED EXCHANGER

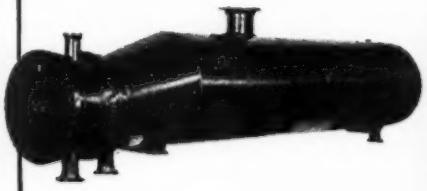
DE-ETHANIZER REBOILER

TWIN G-FIN SECTION BOTTOMS EXCHANGER

This portion of a large modern south-western natural gas absorption plant contains the G-R apparatus listed above. The plant also contains 60 G-R Bentube Sections and a large number of G-R Tubular Heat Transfer Apparatus not shown in the illustration.

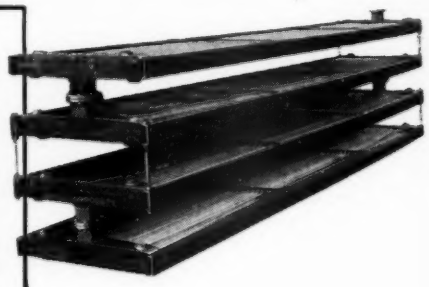
G-R REBOILERS

For producing vapor from liquids heated with steam or hot liquids. The illustrated kettle type has a large vapor space above the tube bundle.



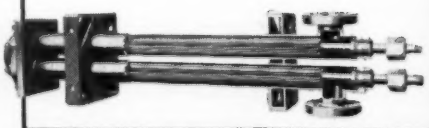
G-R BENTUBE SECTIONS

Patented design of atmospheric or submerged cooling and condensing sections consisting of parallel rows of tubing set with slight initial bow into cast header at each end. Change in temperature causes corresponding change in curvature of the tubes which cracks up and breaks off scale.



G-R TWIN G-FIN SECTION

Standard, interchangeable units of patented hairpin design, consisting of a single G-Fin element, with longitudinal fins within a shell. More than 40,000 of these units are used on practically every heating, cooling or condensing service.



G-R TUBULAR EXCHANGERS

Include many patented features based on 80 years of experience in building heat transfer apparatus. Available in a wide range of types for condensing, heating, cooling or exchanging heat between liquids, gases and vapors.

GRISCOM-RUSSELL: PIONEERS IN HEAT TRANSFER APPARATUS

A good example of G-R "RANGE-ABILITY" at this plant

"RANGE-ABILITY"... the ability to serve efficiently through a wide range of service requirements . . . is a characteristic of G-R Heat Transfer Apparatus.

For example, in G-R Twin G-Fin Sections, this "RANGE-ABILITY" is obtained by simply connecting, in series or parallel, as many of these standard, interchangeable units as required by the duty. The accompanying photograph is a good illustration. This modern natural gas absorption plant uses four banks of G-R Twin G-Fin Sections as follows:

- De-propanizer Exchanger — 3 sections connected in series
- De-butanizer Bottoms Exchanger — 3 banks in parallel, each bank containing 4 sections in series
- Fractionator Feed Exchanger — 2 sections connected in series
- De-ethanizer Bottoms Exchanger — 4 sections connected in series

The same plant uses 60 G-R Bentube Sections (not shown in the illustration) for cooling tower service. These sections are another example of G-R "RANGE-ABILITY" obtained through standard designs, and are operating at pressures ranging from 125 psi to 2750 psi in this plant.

In other types of G-R apparatus, "RANGE-ABILITY" is obtained by designs which cover all duties. For example, the accompanying photographs also show various types of steam-heated and oil-heated reboilers; and the same plant is using many other designs of G-R Tubular apparatus as still feed preheaters, vapor condensers, oil-to-oil exchangers, gas heaters, gas coolers and aftercoolers.

No matter what may be your heat transfer requirements, be sure to consult Griscom-Russell for authoritative ratings and exactly suitable designs of proven performance.

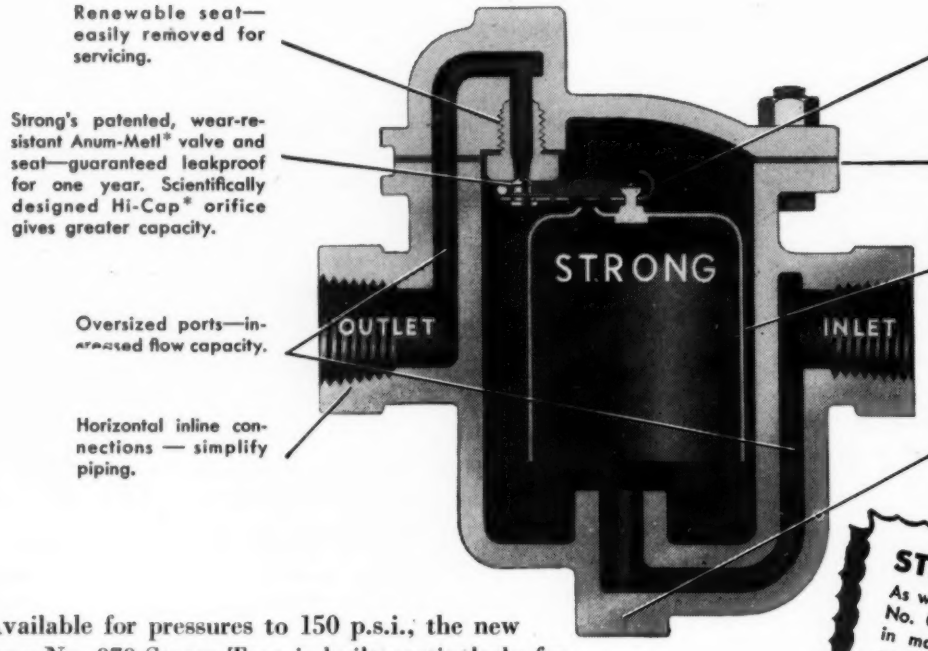
THE GRISCOM-RUSSELL CO. 285 MADISON AVENUE, NEW YORK 17, N.Y.

GR-209

GRISCOM-RUSSELL

At last...

A SMALL TRAP with all these BIG TRAP QUALITY FEATURES!


Renewable seat—easily removed for servicing.
Strong's patented, wear-resistant Anum-Metl* valve and seat—guaranteed leakproof for one year. Scientifically designed Hi-Cap* orifice gives greater capacity.
Oversized ports—increased flow capacity.
Horizontal inline connections — simplify piping.
Stainless 18-8 high ratio leverage.
Large gasket area.
Seamless, deep-drawn, stainless 18-8 bucket —no welds.
Boss provided for drain connection.
STRONG
OUTLET
INLET

Available for pressures to 150 p.s.i., the new Strong No. 070 Steam Trap is built particularly for small drainage jobs where condensate loads are light, yet where conditions call for the well-known economy of a rugged bucket trap.

Strong's 40 years' experience and rigid field tests have been fully utilized in the development of this fine small trap. It embodies all the quality features of Strong's larger traps, making it your best small trap value.

*T.M. Reg., U.S. Pat. Off.

STRONG GUARANTEE

As with all Strong Semi-Steel Traps, the No. 070 is guaranteed against defect in material and workmanship for one year. Strong's patented, wear-resistant Anum-Metl valves and seats are guaranteed leakproof for one year.

Look at these applications— this trap is especially built for them:

LAUNDRIES—Pressing Machines and Ironers, Tumblers, Dry Room Coils, Starchers, Vacuum Stills, Steam Supply Header

INDUSTRY—Unit Heaters (up to 150,000 btu), Pipe Coils, Tire Recap Equipment . . . *wherever small drainage is a problem*

HOTELS, RESTAURANTS—Coffee Urns, Steam Tables, Kettles

HOSPITALS—Sterilizers, Autoclaves

And many more—write today for complete information!

STRONG, CARLISLE & HAMMOND COMPANY
1392 West 3rd Street, Cleveland 13, Ohio

REG. TRADE MARK

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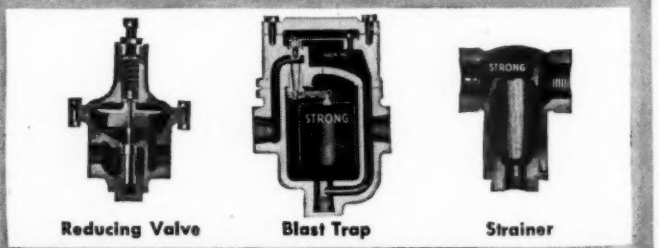
STRONG

STEAM SPECIALTIES



Reducing Valve | Blast Trap | Strainer

FROM LONDON

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A Shell Photograph

TO CARDON

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Typical of the scope of Lummus foreign operations is the construction of a refinery at Cardon, Venezuela, by The Lummus Company of New York and Compania Anonima Venezolana Lummus for The Shell Oil Company of Venezuela. Most of the fractionating equipment, like the hundred ton tower shown on the preceding page, was fabricated in England and Holland, and transported to Venezuela. Staffed offices in London and Paris give Lummus an added flexibility in operation and the advantages of wide purchasing contacts.

In oil producing states in America, all through Europe, in the Near East, Netherlands Indies, South America, China — Lummus has built more than 150 gasoline refineries, upwards of 90 process units for solvent refining and dewaxing of lube oils and more than 300 chemical units, including complete plants of ethylene, butadiene, styrene, phenol.

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NATIONAL CONSTRUCTORS ASSOCIATION

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In many reactions catalyst effectiveness is directly related to size of catalyst. Hooker therefore makes its Aluminum Chloride available in three sizes:

Fine Grind ..... an unscreened material practically all passing 20 mesh.

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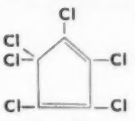
These three sizes have proved to be those most in demand and from them you can select the one that will give you the best results.

HOOKER RESEARCH PRESENTS

HOOKER C-56

(Hexachlorocyclopentadiene)



Molecular Weight	272.79
Freezing Point	−2° C
Boiling Point	236° C
Distillation Range (ASTM)	236 to 245° C
Refractive Index n20/D	1.564
Specific Gravity 15.5°/15.5° C	1.715

Indications are that C-56 (hexachlorocyclopentadiene), a new product of Hooker Research, can be a valuable new organic compound. As a highly reactive intermediate it enters readily into many different types of reactions. Some of the end products are acids, acid chlorides, acid anhydrides, esters, amides, ketones, diketones, quinones, acetals, nitriles and fluorocarbons. The probable fields for the applications of this new chemical are insecticides, dyes, pharmaceuticals, resins, germicides, and fungicides. Hooker C-56 is a yellow to amber colored liquid with a pungent odor.

Technical Data Sheet No. 371 describes Hooker C-56 more completely, gives physical and chemical data, and indicates typical reactions. Copies are available when requested on your company letterhead.

Once you've determined the size you require, you can be sure of smooth reactions, unaffected by catalyst impurities, or analysis changes from shipment to shipment. Hooker Aluminum Chloride, Anhydrous, is always the same—particularly free from iron and other non-sublimables—and every shipment held to the same rigid specifications.

To be sure of uninterrupted reactions in Friedel-Crafts syntheses, polymerization, isomerization and halogenation, select Hooker Aluminum Chloride, Anhydrous.

Additional physical and chemical data on this important chemical are contained in Technical Data Sheet 714, sent when requested on your letterhead. Hooker's Technical staff is also available for consultation and help on the application of Aluminum Chloride and other Hooker chemicals to your purposes.

SPECIFICATIONS

Hooker Aluminum Chloride, Anhydrous	$AlCl_3$
Gray crystalline solid in three sizes.	
Molecular Weight	133.3
ANALYSIS	
Aluminum Chloride	98.5% min.
Iron	0.05% max.
Non-sublimables in air at 950° C	1.5% max.

From the Salt of the Earth

HOOKER ELECTROCHEMICAL COMPANY

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UNDIVIDED RESPONSIBILITY IN ONE ORGANIZATION

PETROLEUM PROCESSING
DECEMBER, 1948

Staff Report from New York

Better Heat Utilization Achieved In New Houdriflow Cracking Process

Economics of New Catalytic Cracking Unit Design Told At Annual Meeting of Chemical Engineers; Symposium on Chemical Plant Location Also Commands Wide Attention

By WILLIAM C. UHL
Equipment Editor

SAVINGS in construction through design changes and in operating costs through a better heat balance give a substantial cost advantage for the Houdriflow catalytic cracking process over the conventional Thermofor process.

This point and other data on the recently announced development of the Houdry Process Corp., were brought out in a paper by Houdry engineers presented at the 41st annual meeting of the American Institute of Chemical Engineers in New York Nov. 8-11.

The cost advantage for Houdriflow over the TCC process was estimated at $571 per day for the optimum economic design, which is a modified heat-balanced system for a 5000 b/d plant, including the following cost factors: utilities, catalyst, maintenance, and amortization of the original investment over four years.

Higher catalyst/oil ratio, resulting in a reduction in coke deposition, was cited as the fundamental improvement in the TCC process by the Houdriflow system, according to C. G. Kirkbride, director of Houdry's Marcus Hook research laboratories. In his paper "Economics of Moving Bed Catalytic Cracking Processes", he listed the following specific changes from conventional (TCC) design incorporated in the new process:

"Replacement of the mechanical elevator with the less expensive gas lift for vertical transportation of the catalyst. Elimination of the tar separator and the vapor charge superheater. Reduction in size of kiln and cooling coils therein."

In addition to the use of pneumatic catalyst lift, the Houdriflow design superimposes the reactor above the kiln in one integral vessel. The kiln has been redesigned to operate under a pressure of about 6 to 10 psig., reducing its size and providing a source of gas for catalyst lift.

The most far-reaching revision in the kiln, Dr. Kirkbride said, "has been its simplification from multiple split-flow burning zones to one or at most two countercurrent zones. Hot regenerated catalyst flows from the kiln down through a seal leg to the pneumatic lift introduction chamber, where it is picked up by the hot flue gases and carried to the top of the lift. In the top hopper the flue gas and catalyst are disengaged, the flue gas exhausted, and the catalyst discharged through a seal leg to the reactor." The balance of the operation compares to conventional TCC technique.

The cost comparisons for Houdriflow and TCC and general design data are shown in Table 1, which is a composite summary of several tables presented by Dr. Kirkbride. Five different unit designs were used in developing the figures for this comparison. Each is designed to crack approximately 5000 b/sd of a 29.0° API Mid-Continent gas oil at 0.5/1 recycle ratio to 60% conversion over natural clay catalyst at average cracking temperature of 900° F.

Case I is based on a single split bucket elevator circulating about 75 tons of catalyst per hour to give a catalyst/oil weight ratio of 1.7/1.0 on total feed. The other cases represent increasing C/O weight ratios. Case IV is a heat balanced operation and represents the economic optimum of C/O; i.e., for this particular stock, catalyst, conversion and recycle ratio, no heat need be removed from the kiln nor is it necessary to heat the feed above its normal exchange preheat temperature of 525° F.

"Because of the inherent inflexibility of a heat balanced unit, however, a modified version of Case IV is included," Dr. Kirkbride stated. "The modification (Case IV-A) consists of the addition of fired preheat and kiln cooling capacity equivalent to 10% of the normal regeneration load. The effect of this change on the economic picture is merely a measure of the cost of flexibility."

In explaining the cost figures showing savings over conventional TCC, it was said that savings in amortization and interest charges were calculated on a total saving equal to the

TABLE 1—Comparison of TCC and Houdriflow Units, 5000 B/SD Design Capacity

Case	I	II	III	IV	IV-A
General Design Data:					
Type	TCC	Houdriflow			
Catalyst Transportation	Elevator	Flue Gas Lift			
Catalyst/Oil ratio, wt.	1.7	3.4	5.7	7.3	7.3
Coke/Cat ratio wt.	0.0236	0.0118	0.0070	0.0055	0.0055
Space rate, wt/hr/wt.	1.2	2.3	3.1	4.1	4.1
Avge Cracking Temp. °F.	900	900	900	900	900
Catalyst		Natural Clay			
Reactor		Concurrent			
Kiln type	Multi-Zone	Split Flow	Counter flow		
Cooling Coils	Yes	Yes	Yes	No	Yes
Fire Preheater	Yes	Yes	Yes	No	Yes
Savings over 1.7 C/O TCC:					
Utilities, $/day	....	251	260	295	295
Catalyst, $/day	....	0	—42	—72	—72
Maintenance, $/day	....	29	39	53	45
Amortization, $/day	....	157	217	295	250
Total, $/day	....	437	474	571	518
Total over 4-yr period	....	$575,000	620,000	751,000	680,000

initial saving at 2-1/2% for four years. Table 1 shows, in terms per day, savings in amortization based on these conditions and an 0.90 stream factor.

In general, it is believed that maintenance costs for the Houdriflow design will be lower than the average maintenance cost for TCC units, which is 5% on investment per year. However, no actual operation data has as yet been obtained, and the 5% figure from TCC operation has been applied in the Houdriflow estimate.

No commercial installation of Houdriflow has as yet been placed in operation. One plant of about 40,000 b/d design capacity, understood to comprise six separate Houdriflow units, is under construction at the Toledo refinery of Sun Oil Co. with completion expected by the end of 1949. Another 6700 b/d unit is being built by Tide Water Associated Oil Co. at its Drumright, Okla., refinery; and a third unit, of 5000 b/d capacity has been announced for the Blue Island, Ill., plan of Petco Corp.

The utilities figures in Table 1 include steam, fuel, power, cooling water, and boiler feed. Of these, both steam and cooling water actually are minus factors. Greater quantities of steam are required as the design approaches heat balance conditions. However, conversely, fuel requirements decrease continually as the catalyst/oil ratio is increased and overbalance increased steam needs.

In any moving bed system, catalyst make-up is required to maintain the equilibrium activity and to compensate for attrition losses. In the analysis summarized in Table 1, only attrition losses have been included, because makeup rates for both types of catalyst lift are not yet available. The rates used are 0.03% of catalyst circulation for TCC and 0.015% for Houdriflow. Costs are based on clay catalyst at $120/ton. The higher catalyst/oil ratio designs show a net loss in the comparison because they will require a greater make-up.

In answer to a question during the discussion period, it was said that attrition loss rate had dropped from 0.015% for clay catalyst to 0.009% when the synthetic bead catalyst was used. It was explained that attrition studies were carried out in semi-works equipment of the gas lift; comprising two vertical columns 175 ft. high, one of 6-in. diameter and the other 12 in.

Industry vs. Atomic Bombs

In a widely-discussed paper during another session of the AIChE meeting, it was stated that the security of America's chemical industry in any future war will depend on how well it disperses its new plants. The paper, presented by R. F. Dimmitt of the National Security Resources Board and prepared by F. E. Henderson of that government office, was part of a plant location symposium.

American industry must count on being on the receiving end of atomic bombs, he stated, if another war comes. "We know from past history that practically all improved war weapons developed in the past have been used in subsequent wars. And there is no known defense against the atomic bomb except space itself."

A manufacturer can determine for himself how important a proposed plant site would be to an enemy, according to Dimmitt. He should first draw a three-mile radius around his plant site, then "he should list every facility within this area which might be of interest to an enemy planner."

Fuel Costs Rising

Another speaker in the plant location symposium pointed out that adequate fuel supplies are a factor of great importance in the location of many future chemical plants. H. A. Sommers, Mathieson Chemical Co., presented some interesting opinions relating to natural gas in his paper.

"There was a time," he said, "when users of natural gas did not worry too much about the future. The supply appeared to be practically unlimited. Cheap gas is the cornerstone upon which many of the important chemical plants in the Gulf coast area were built." Today, with increased local demand and considerable export of gas from that region, the demand has more than caught up with the supply. "This has already greatly increased the cost of gas on the Gulf during the past few years, and those familiar with the problem say the cost will probably double in the next five to ten years."

However, the situation on coal is even worse, he said. "The cost at the mines is constantly rising due to increased labor and other costs. This, coupled with higher freight rates makes for an expensive fuel."

On the other hand, the use of petroleum hydrocarbons as a chemical raw material has brought problems to the chemical industry, Marcus Sittenfield, a consulting chemical engineer of Philadelphia, told Institute members. The petrochemical industry is not only large and growing, but it is also economically complicated. "In selecting a site for petrochemical plant, not only the usual factors of labor, land, taxes, and utilities must be studied," he stated, "but also the selection of the product to be manufactured, a study of its uses, the location of its major users, determination of the processes to be employed in its manufacture, and a study of the raw materials."

Until now the result of such studies has been a tremendous growth in chemical production in the Southwest, a production based on petroleum. One factor which may curtail additional expansion in this region, according to Mr. Sittenfield, is the recent Supreme Court ruling outlawing basing point pricing systems. "The change in freight rates resulting from this decision may add up to 15% to the cost of building a plant in an area such as the Southwest."

Water Supply Dwindling

The rapid exhausting of underground water supplies may seriously affect the industrial future of various parts of the country, S. T. Powell and G. G. von Lossberg, consulting engineers of Baltimore, told AIChE members. "Already suffering are the areas of Louisville, Ky., Southern California, the coastal areas of Texas, and Mexico City."

"The dewatering of the sands has been so extensive in Eastern Texas that there has been a land subsidence over a considerable area, ranging from 12 to 18 in. Corrective measures are now in progress to relieve this situation by curtailment of the withdrawal of water from the underground areas and substituting surface water."

Walker Award to Watson

Dr. Watson

Kenneth M. Watson, professor of Chemical Engineering at the University of Wisconsin and engineering consultant, received this year's William H. Walker Award at the American Institute of Chemical Engineers' annual meeting in New York last month. The award is an annual presentation given for a contribution of outstanding importance in the chemical engineering literature. Dr. Watson is co-author of "Industrial Chemical Calculations" and the three-volume "Chemical Process Principles," and has had approximately 50 papers published in technical journals, including a dozen in PETROLEUM PROCESSING and the *NPN Technical Section*.

Dr. Watson at one time was Director of Engineering Research for Universal Oil Products Co., and in 1941 went to Gulf Oil Corp. as chairman of the Technical Committee of the Neches Butane Products Co.

MANAGEMENT ORIENTATION WEEK

A Modern Feature of Refinery Training

By CARL G. MORRISON and W. A. ABERCROMBIE

Meet the Authors

C. G. Morrison is assistant head of the Maintenance and Construction Division and W. A. Abercrombie is Employee Relations research assistant, at the Baton Rouge refinery of Esso Standard Oil Co.

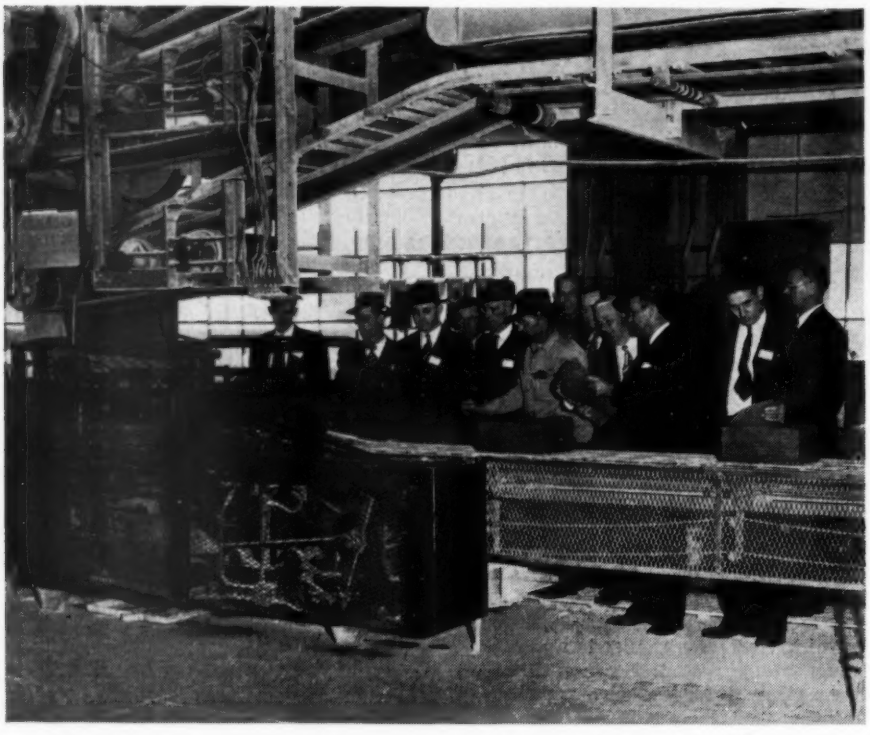
IF YOU ARE A MEMBER of a large industrial organization no doubt you have heard the remark, "I've been around this place for 30 years and still don't know what's going on in the other departments."

This statement reflects, to a degree, the situation that formerly existed at the Baton Rouge refinery of the Esso Standard Oil Co. The refinery covers 2400 acres, employs 9000 people and the management recognized that there was a serious need, among the several hundred employees representing the management group, for an intimate understanding of intra-refinery organization, policy, and problems.

The problem itself was an old one, but the technique employed at Baton Rouge in attacking it suggests a new thought in the field of foreman training. Five hundred and fifty-seven management representatives—from first line foremen through the highest management level—took part in the program. To date, nothing but praise has been heard from these men concerning the value of their "orientation." This training is generally credited with being the most beneficial ever attempted at this refinery.

Each week for a year, starting in April, 1947, groups consisting of from 12 to 15 members of management, each from a different department, were relieved from all company duties and visited each department and company official in the huge refinery. By the end of the week the group had visited all of the major departments, had heard the department or division head discuss the activities of his unit of the refinery, been given the opportunity to ask questions, and been shown the more important refining processes and operating equipment. Each man also had been provided with a book for ready reference to much company and refinery information. It is significant to note that, in each case the department head or his immediate assistant discussed his business with the orientation group. The inclusion of the higher levels on man-

Management group meets with Asst. General Manager Voorhies to discuss mutual problems during Orientation week



Orientation group examining synthetic rubber in the finishing operation, with explanation by General Foreman N. F. Black

agement, as leaders of discussions and conductors of tours, is considered a key factor in the success of the orientation training.

Features of Program

This management orientation program contained the following features not normally embodied in the usual training courses:

1. The discussion leaders for the program consisted of 35 key members of the refinery management, including department and division heads, the assistant general manager, and the general manager.

2. No discussion leader was with the group for more than one and one-half hours.

3. No professional training personnel, or "outsiders," were used.

4. The work of the refinery Training Department on the program consisted primarily of co-ordinating and planning. The co-ordinator worked full time on the program for three months before the starting date. His work covered the development of a detailed itinerary for the Orientation Week. It included the co-ordination and preparation of texts for discussion and for inclusion in the individual books (texts were actually prepared by the respective department heads), procuring or preparing training aids as required by the discussion leaders, scheduling of each meeting at a time and place that would not conflict with other activities, and arranging other details such as transportation of the groups, method of inviting the participants, and the arrangements for relaxation periods.

5. Each participant was treated as a guest of the refinery during the Orientation Week. Any expenses incurred on meals, transportation, or refreshments were borne by the company. Some of the enjoyable and beneficial features of the program included a 30-minute inspection of harbor facilities on the Mississippi in a company-owned river launch, and a 15-minute trip to the top of one of the refinery's giant "cat crackers".

TABLE 1—Typical Day's Itinerary, Management Orientation Program

Wednesday

7:45- 9:25—Utilities & Light Ends Department
- 7:45- 8:35—Department Head's Office
- 8:40- 8:50—No. 3 Boiler House
- 8:55- 9:15—No. 2 Alkylation Unit
- 9:15- 9:25—No. 3 Debutanizer and Splitter Unit

9:30-10:40—Cracking Department
- 9:30-10:15—Department Head's Office
- 10:15-10:40—Inspection of units, including one Catalytic Cracking Unit

10:45-12:25—Paraffin & Lubricating Department
- 10:45-11:10—Department Head's Office
- 11:10-12:25—Inspection of Nos. 1 & 2 Phenol Plants, Propane Deasphalting Plant, Propane Dewaxing Plant, Filters, Paraffin Presses and Refrigeration Equipment, and Sweaters

1:20- 2:35—Inland Waterways Division
- 1:20- 1:40—Office of Assistant Head of Division
- 1:45- 2:15—River Front Inspection (Boat Tour)
- 2:20- 2:30—Quarterboat

2:40- 3:00—Oil Conservation Department

3:10- 4:10—Package & Shipping Department
- Discussion and Inspection of Facilities

All Parties Benefit

The program produced a refreshing effect on the department heads, the general manager, and the assistant general manager. These people met a different orientation group at the same time each week during the year, and now they express regret that the program has been completed and they are looking forward to again talking in such a desirable atmosphere to the management personnel. The meeting between the department heads and higher management with the groups afforded an opportunity for a friendly, informal chat about one another's problems. It gave the department head an opportunity to show his own department to men who, in many cases, had worked with him in the "Yard," and an additional opportunity to solicit their cooperation in the future.

It is generally regarded that the one most important accomplishment of the program is that today the various intra-refinery groups work with a clearer understanding and appreciation of the problems associated with the functioning of their departments or offices in relation to the overall operations of the refinery. Such an understanding and appreciation inherently leads to higher morale and greater efficiency.

One boilermaker foreman with 32 years' service made the following observation after visiting the Stores Department, "I always thought those people were not very busy, but next time I'll think twice before I jump down their throats when I don't get want I want in 15 minutes." Similar expressions of a new understanding

were voiced by nearly all participants at one time or another during the week. Numerous participants indicated that the highlight of the week was the visits to the friendly offices of the general manager and the assistant general manager.

Since the completion of the program, there appears to be more of a co-operative feeling among the foremen and the various management groups. The average foreman is more familiar with the units and the processes used in the refinery, the mechanical facilities, the staff divisions, and the relationship between the various divisions. Perhaps most important, he has established a personal contact with the people responsible for the operation of the refinery.

A careful handling of the most minute detail before the program started and the active interest and participation of all members of management, especially the discussion leaders, contributed to the effectiveness of the program.

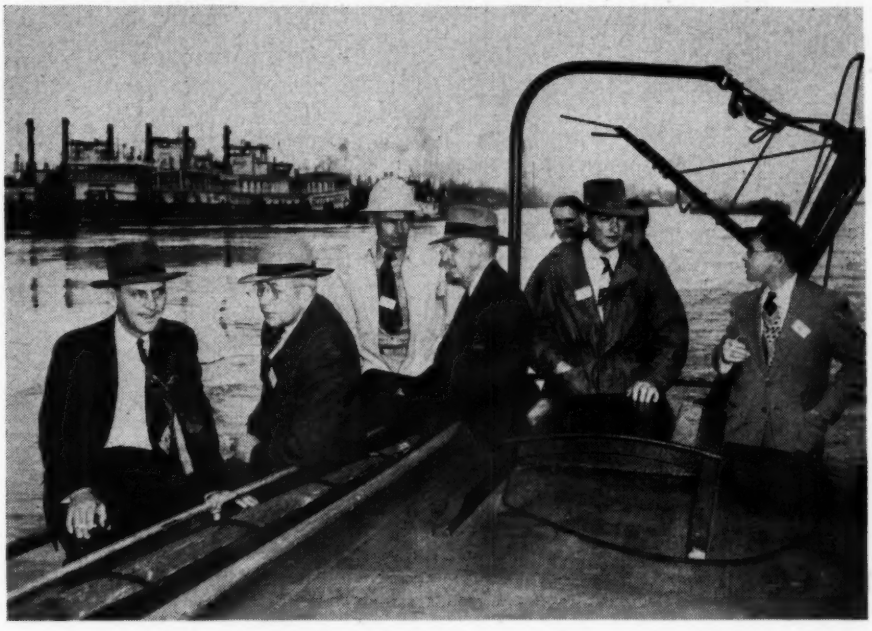
The program operated each week on a definite schedule. One member of each selected group was designated as group leader and, during the week preceding the orientation tour, this group leader was furnished the necessary information which would enable him to keep the group moving according to schedule. The enthusiasm created in the open discussions quite often made it necessary for the group leader to remind the discussion leader that his time had expired, and the group would have to proceed.

At the first meeting of Orientation Week, each participant was given a looseleaf notebook, on which his name had been engraved, and in which he filed pertinent material such as summaries of departmental activities, organization charts, and simplified process flow plans handed to him in the various departments during the week. At this first meeting, a group picture was taken and a copy furnished to each participant. A copy of this picture was also given to each discussion leader before the group arrived so that the discussion leader would know in advance whom he was to expect in each group. Table 1 is a typical day's itinerary indicative of the manner in which the program was conducted.

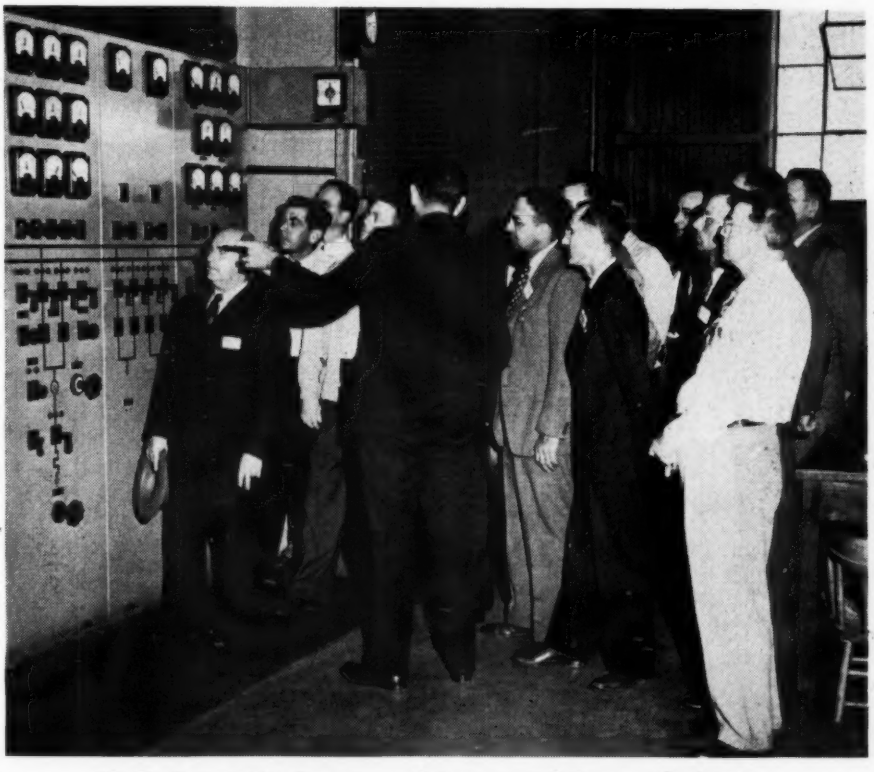
Program to Be Repeated

Local management considers this program the most successful foreman training ever attempted at the refinery. The benefits, though largely intangible, are believed worth many times the cost of the program. Current plans call for a reinstitution of this orientation training for short periods from time to time so that the men who have most recently been promoted to a foreman status may have the advantage and opportunity to take part in the Orientation Program.

This type of training is not suggested for all companies. It is recognized as having its primary utility in plants of some magnitude, but with modifications relative to the length and coverage, it could easily be adapted for any firm employing more than 500 people. If your plant is confronted with a situation similar to that encountered at the Baton Rouge Refinery, it would be well to take a new look at an old problem and perhaps you will agree that time alone does not orient a management representative on company problems, policy, or organization. A well-organized formal program should do the trick.



On the schedule for Orientation Week is an inspection of harbor facilities on an Esso Launch



H. S. Bourgeois, Foreman of Power and Steam Production explains function of power control board

MODERN SL
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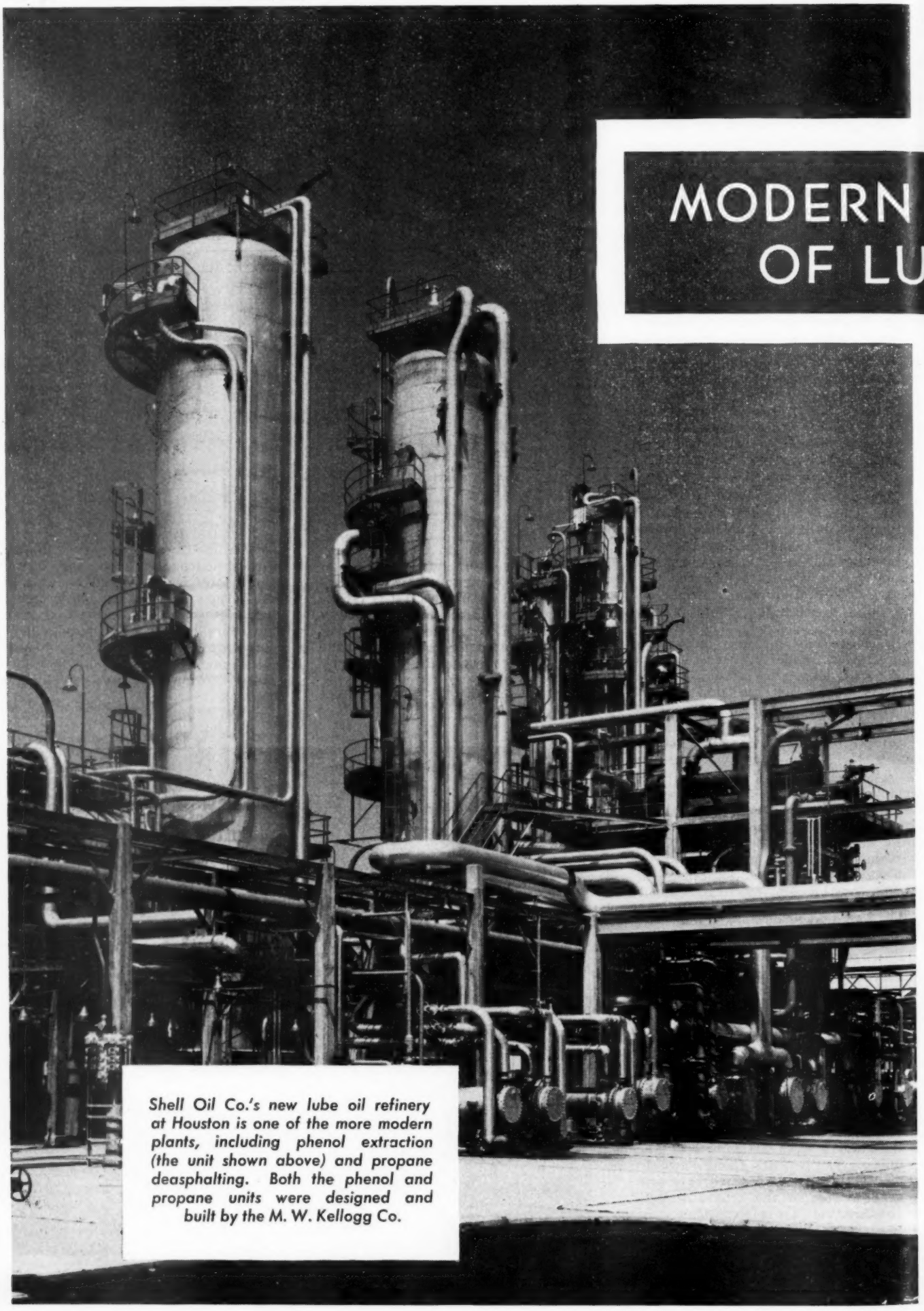


Shell Oil Co.'s new lube oil refinery at Houston is one of the more modern plants, including phenol extraction (the unit shown above) and propane deasphalting. Both the phenol and propane units were designed and built by the M. W. Kellogg Co.

SLVENT REFINING UBRICATING OILS

By V. A. KALICHEVSKY
Consulting Chemical Engineer
Magnolia Petroleum Co., Beaumont

Article 1

THE COMPLEX NATURE of lubricating oils and the lack of information regarding the effect of their various constituents on engine performance for many years prevented the development of the most efficient methods for their refining. Current requirements of good lubricants undergo continuous changes with the progress in the design of industrial machinery and the accumulation of theoretical knowledge of lubrication problems. Even at the present time many lubricating oil questions remain unelucidated, notwithstanding the remarkable attainments of petroleum refining technology during the past several years.

Crude lubricating oils consist of a very large number of chemical compounds each present in very small quantities which makes their isolation a practical impossibility. A small variation in the chemical structure results in a barely perceptible change in their physical and chemical properties. For this reason no sharp dividing line can be drawn between the individual compounds or even groups of compounds which are present in oils, and the analytical methods devised for this purpose are by necessity arbitrary. A mere statement that a sample contains certain percentages of asphalt or wax is of little value unless the procedure used for their determination is specified. However, to simplify further discussion these terms are employed with the understanding that they are used in a qualitative and not in a quantitative manner.

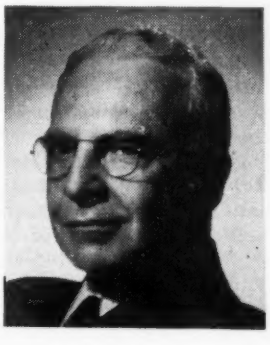
Solvents are capable of resolving crude oil fractions into various classes of compounds which differ from each other by their solubility characteristics. The major classes of direct interest to the refiner are asphaltic substances, resins, low viscosity index constituents, high viscosity index constituents, pseudo-waxes and waxes. As already mentioned, the borderline between these classes is easily shifted by slight changes in the conditions of extraction because of the absence of distinct demarcation lines. Likewise, each individual group may be arbitrarily split into narrower fractions by varying the solvent treats.

Asphaltic substances comprise carboids, carbenes and asphaltenes named in the order of the increase in their relative hydrogen to carbon ratio and solubility characteristics.(1) The first two are seldom if ever present in crude oils although they are common constituents of natural and artificial asphalts and highly oxidized oils. On diluting the oil with light hydrocarbon solvents such as petroleum ether or liquefied propane, they are precipitated from the oil where they are present in colloidal solution. The amount of the precipitate depends on the volume and molecular weight of the solvent as well as on the temperature.

Considering their poor solubility characteristics the carbon content of the asphaltic substances is surprisingly low. For instance, crude oil

The Author . . . The Articles . . . The Illustrations

The accompanying is the first of a group of articles by Vladimir Anatole Kalichevsky presenting the technical aspects of the solvent refining of lubricating oils. With the articles will be presented illustrations of new lube oil plants and their equipment. Deasphalting, dewaxing, refining with selective solvents and other topics will be discussed in the articles in the light of present improvements in the various processes and their principal equipment.

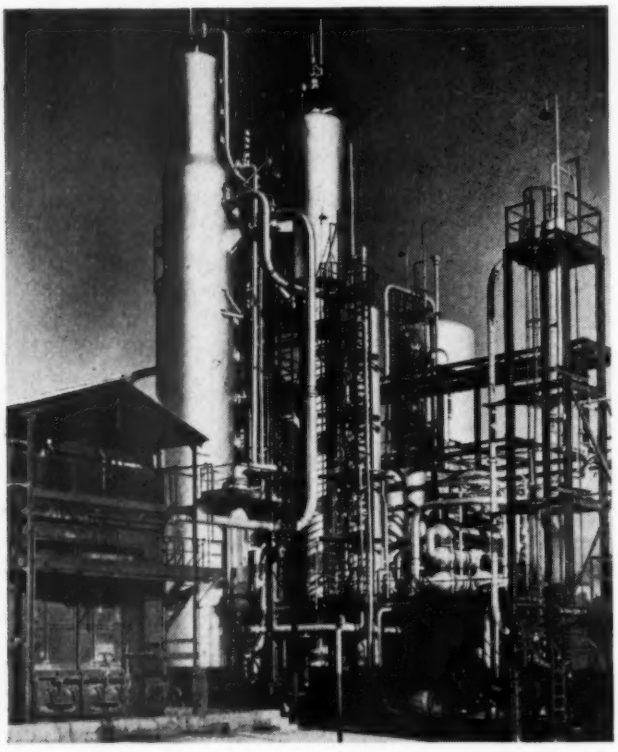


Preliminary to the discussion of the methods themselves data is given on the composition of crudes as related to their value as lubricating stocks, evaluation of oil quality, general aspects of solvent refining and so on.

The author of the text is a foremost authority in the field of lubricating oil manufacture. Among his technical books are the "Chemical Refining of Petroleum," "Modern Methods of Refining Lubricating Oils," (both American Chemical Society Monographs), and, in popular style, "The Amazing Petroleum Industry." Many articles by him have appeared in scientific journals and he is the author of numerous patents in lubricating oil manufacturing and other fields.

Kalichevsky was born in the Caucasus of Russia, came to this country in 1921 and studied at California Institute of Technology, receiving his B.S. in chemical engineering in 1924. He was research chemist with Union Oil Co. of California and later with Standard Oil Development Co. From 1931-37 he was section supervisor of the Research and Development department of Socony-Vacuum Oil Co., and from 1937-44 general supervisor of the same organization. In 1944 he was made consulting chemical engineer for Magnolia Petroleum Co., Beaumont, Texas, which position he now holds. He has recently been nominated for president-elect of the American Chemical Society.

His early education was in Russia, in the Corps of Pages and in the War College. Following World War I, in which he served as a captain in the Imperial Russian Guards, he fought against the Bolshevists in 1919-20, receiving both Russian and French decorations.



5000 b/d furfural extraction unit, designed and built by Lummus Co.

contains from 83 to 87% carbon while asphaltenes are composed normally of 85-86% carbon with observed variations between about 80 and 90%. In addition to carbon, asphaltenes may have 5 to 10% hydrogen, 0.5 to 11% sulfur, 2 to 8% oxygen and sometimes very appreciable quantities of nitrogen. These differences in the results of elementary analyses of asphaltenes indicate that they can hardly be regarded as substances of uniform chemical structure.(2)

Resins which are usually included in the asphaltic substances represent the intermediate fractions between asphalt and oil. Their molecules are still large although they are smaller than those of asphaltenes and particularly those of carbenes and carboids. It is possible that, notwithstanding the observed increase in the average hydrogen-to-carbon ratio of all the aforementioned asphaltic constituents, the real difference on which their classification should be based is the size of the molecules and not their chemical composition. Resins form semi-colloidal or possibly even true solutions with the oil. However, because their molecules are still of considerable size, they may be thrown out of solution by applying large volumes of precipitants and by properly adjusting other treating conditions. For this reason asphaltic and resinous precipitates obtained at different plants may show wide variations in properties even though they arise from the same crude source.

The oil left after removing asphaltic substances and resins is again not a uniform substance. Some portions of it are indistinguishable from light resins and others from the pseudo-waxes. Those closer to resins are undesirable constituents of high grade lubricants because they are rather unstable in service and show wide variation in viscosity with temperature, i.e. their viscosity index is low. Depending on the desired quality of product the refiner establishes in each particular instance the dividing line between the low and high viscosity index constituents. The intermediate fractions may thus be included in either portion of the oil depending on the specifications for finished materials.

Solvents employed for separating asphaltic substances from the oil cannot be used for this purpose because the differences in molecular sizes are small. Selective solvents suitable for effecting the split are those which have preferential solubilities towards aromatics. This is explained by the fact that an increase in the proportion of aromatic nuclei in a hydrocarbon molecule appears to parallel the viscosity index characteristics. The higher the aromatic ring content the less desirable is the oil quality.

The complex nature of lubricating oil molecules does not permit their classification into aromatic, naphthenic or aliphatic compounds because all these structures might be present in the same molecule, making the differentiation impractical. Likewise naphthenic rings may impart better solubility characteristics to the molecules than the aliphatic chains. Similarly, it is not precluded that a purely naphthenic compound might

This Month's Cover Picture

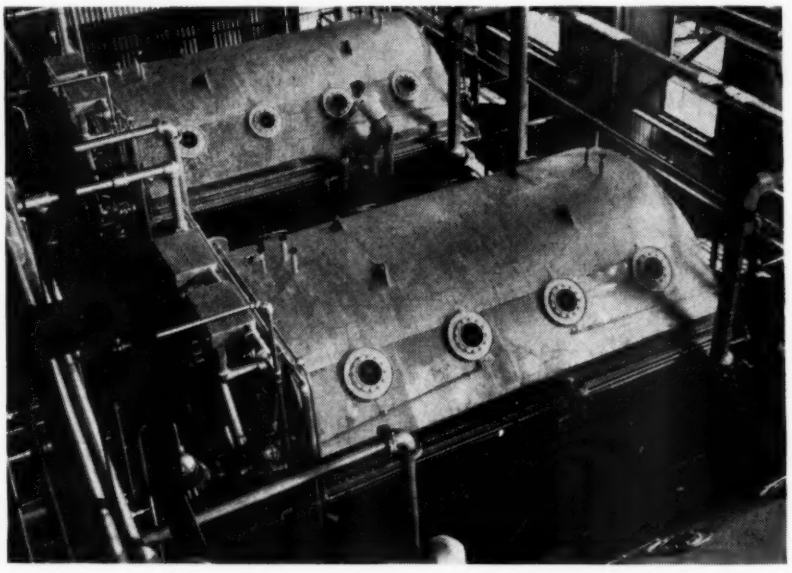


Photo courtesy the Pennzoil Co.

A battery of six new type, continuous rotary drum filters, each with a filter surface of approximately 500 sq. ft., removes wax from the solvent-treated charge stock in the MEK-benzol unit of the Pennzoil lube oil refinery at Oil City. The unit has a charge capacity of 2500 b/d of neutral stock and 1600 b/d of cylinder stock. The filters were supplied by the General American Transportation Corp., and the dewaxing unit itself was designed and constructed by Arthur G. McKee & Co.

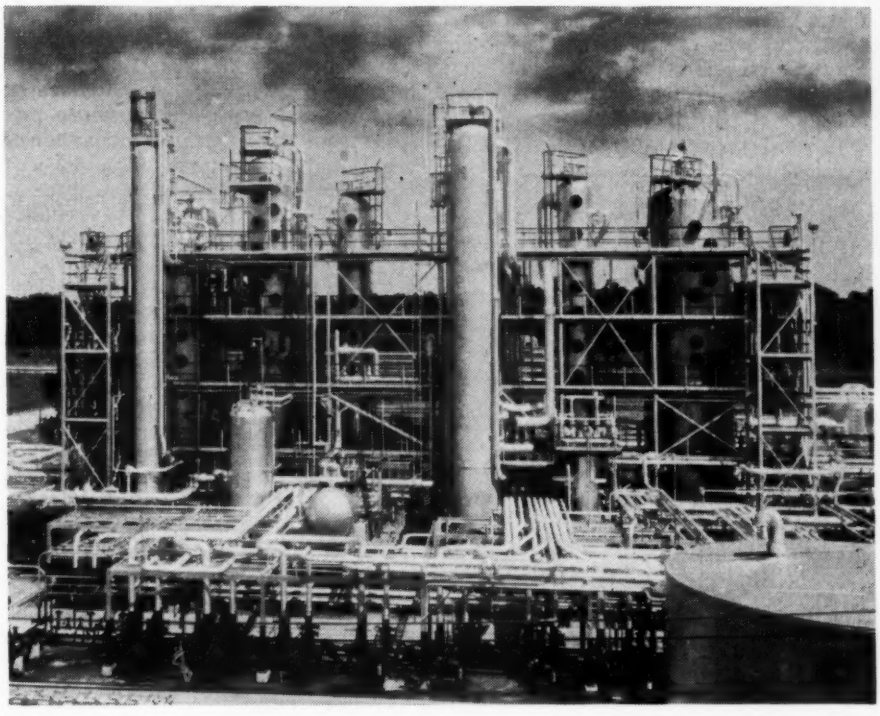
be more soluble in solvents than an aromatic compound containing many aliphatic chains. Absence of experimental data permits unlimited speculation on this subject which is of no significance whatever until more information is available. For this reason the use of the quasi-chemical terms in the present write-up is restricted to the general behavior of the lubricating oil components and not to their actual structures.

When selective solvents are applied to oils containing asphalt they are incapable of precipitating or removing the colloidal asphalt particles which become dispersed both in the raffinate and in the extract phases. However, resinous substances which form more or less true solutions and seem to contain a considerable proportion of aromatic nuclei may be dissolved by such solvents.

Stability of oil fractions arising from the same crude oil usually improves with the rise in their viscosity index caused by an increase in the severity of solvent treats. This generalization does not mean, however, that viscosity index is indicative of oil stability if comparisons are extended to other crude oil sources. For instance, Coastal oils have a low viscosity index but in some instances are preferred to the high viscosity index paraffinic oils. A fraction of comparable viscosity index isolated from the latter oils will be found highly unstable. Similarly, the Mt. Pleasant (Michigan) crude has a viscosity index which is higher than that of any other crude oil investigated by the writer, but its stability is poor.

The above shows that the refiner must be careful in establishing his crude oil supply and in determining the proper degree of refining for each individual product manufactured. The efficiency of the available solvent extraction equipment must also be taken into account. For instance, if the efficiency is low, the separation between the various oil components will not be satisfactory and some of the low viscosity index constituents will be included in the refined oil. This might be corrected by increasing the extraction severity at the expense of yield although the product will not be identical with the one obtained from the same crude oil fraction if the separation is sharp. The overall effect will be similar to that observed in operating distillation equipment having low and high fractionating efficiency.

Pseudo-waxes are intermediate substances between the high viscosity index constituents and waxes. Because of their tendency to congeal at relatively high temperatures their removal from the oil may be desirable although in all other respects they might not be objectionable or may even be advantageous. Similar considerations apply also to waxes.



Phenol extraction unit at Humble Oil & Refining Co.'s lube oil refinery at Baytown, Texas. The unit was designed and constructed by the M. W. Kellogg Co.

Waxes and pseudo-waxes are separated from the oil by chilling, usually in the presence of solvents, to reduce the oil viscosity at low temperatures, and the solidified material is removed by filtering or centrifuging. Ideal solvents should be able to keep in solution all of the oil constituents except those that are precipitated. Although these requirements are somewhat different from those demanded from deasphalting and selective solvents, they do not preclude their use if the solvent properties are modified by methods to be described in other articles of the series. It may be noted that theoretically it should be possible to remove the waxy constituents by applying selective solvents at temperatures at which the wax is liquid. However, in this instance the decrease in solubility of hydrocarbons does not parallel the rise in the melting point and thus prevents the sharp separation of oil from wax.

Three types of solvents are thus in use in crude oil refining: deasphalting solvents, selective solvents and dewaxing solvents. Because of the absence of sharp dividing lines between the various oil constituents, the sphere of action of the individual groups of solvents is also not sharply defined. For instance, resins may be removed by deasphalting and by selective solvents; or pseudo-waxes can be separated from the oil by dewaxing or to a large extent, by selective solvents although the latter method is not yet practical.

In preparing finished oils the refiner is confronted with the problem of isolating the desirable fractions by a suitable combination of distillation and solvent refining procedures. A considerable amount of work is involved in determining the optimum degree of refining which is aggravated by the absence of quick methods for estimating some of the important properties, particularly oil stability in service. This is due to the existence of a very large number of variables to which the oil might be exposed under actual operating conditions and the importance of securing the desired information in a reasonable length of time so as not to extend preliminary investigations beyond practical limits. Difficulties encountered in this connection may be visualized from the following discussion of the effect of changing only one of the variables, namely, temperature, on the oil behavior.

Oil should last for a considerable length of time without showing any appreciable deterioration in properties. In extreme cases, such as with cable oils, normal life is estimated by decades. This necessitates development of accelerated aging tests which involve an increase in the severity of the conditions to which the oil is exposed in order to speed up the testing procedure. Almost always, the temperature is raised to secure desired results. Unfortunately, not all of the chemical reactions are af-

fected equally and the respective positions of oils on the stability scale may be reversed by changing the temperature level at which the comparisons are made.

In correlating the data obtained in accelerated laboratory tests with those observed in operating engines, similar discrepancies may appear. For instance, an oil showing lower stability in the laboratory may be found superior in an engine to an oil arising from some other crude source exhibiting a higher laboratory stability. Furthermore, if the first oil is refined to produce a material which is equal to the second oil when tested in the laboratory, it might be inferior to either the second oil or to the same oil less drastically treated, when the engine tests are employed. Similar considerations apply to all other variables, such as oxygen concentration, pressure, nature and surface of metals used, etc., that are introduced in laboratory testing for simulating or accelerating service conditions.

Notwithstanding the above shortcomings of accelerated tests, it is not possible to dispose of them because of the aforementioned time factor and the tremendous expense involved in extensive service tests. However, it is always desirable to expose the oil to more than one dissimilar laboratory test and in the case of discrepancies not to condemn the oil without further investigation.

Engine tests conducted under ideal laboratory conditions are open to similar criticism. One engine is capable of reproducing only one set of variables while the differences in driving conditions show almost infinite variations. Attempts to reproduce "average" driving conditions, or all other similar "averages", have little meaning because complaints usually arise not from "average" but from unconventional operation which is more frequently encountered in practice than might normally be expected. The final proof of product quality is obtained, therefore, only after it reaches the market and preliminary experimentation merely serves to reduce the possibility of failure to a minimum. This is also substantiated by the fact that the general public relies more on branded products of well-known companies with a wide experience and sound financial backing necessary for thorough testing of their products than on unknown products that appear on the market from time to time.

While an extensive investigation of oil quality is a very difficult undertaking, evaluation of its physical characteristics at the time the oil is made can be done rather easily. After the source of crude and the degree of refining are established the product quality is controlled by means of conventional tests involving determination of viscosity, gravity, pour point, etc. and calculation of simple functions such as viscosity index or viscosity-gravity constant.

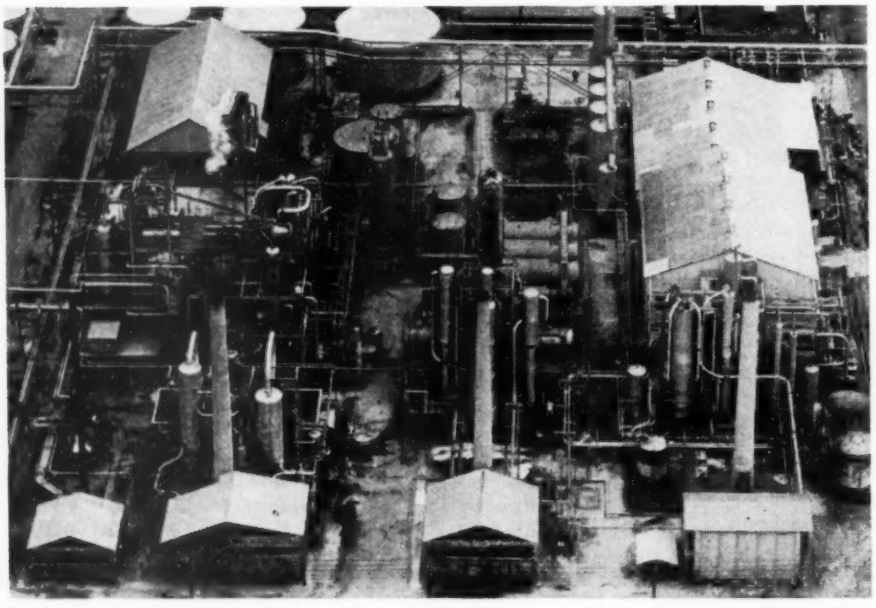
This is permissible because physical and chemical properties are to a certain extent interrelated if the charge to the unit is constant and fluctuations in the treating variables are kept within reasonable limits. However, even under such conditions it is highly desirable to verify the uniformity of product quality by determining more than one of its characteristics. This is due to the fact that it is possible to keep one of these characteristics constant while varying the rest. For instance, it has been demonstrated that in Duo-Sol refining a Mid-Continent residuum the carbon residue of the raffinate could be varied between 0.18 and 0.35 or even more while viscosity index was kept at 100.[3] The choice of control tests depends on the type of process employed because some of the product characteristics are changed appreciably in the course of solvent refining while others are affected primarily by the distillation technique or nature of the crude oil charge.

In deasphalting operations the carbon residue may be considered as the most important control test because it is closely related to the asphalt and resin content of the oil. Color is another indication of the degree of deasphalting, particularly if taken by employing suitable colorimeters and by diluting the oil with naphtha or benzol which might be required to improve the accuracy of measurement. Changes in viscosity and gravity of the oil are also appreciable after the asphalt is removed.

The effect of selective solvents is best determined by estimating viscosity index or viscosity-gravity constant of the product. Viscosity-gravity constant is of particular importance with waxy or very low and very high viscosity oils when their viscosity index cannot be conveniently measured. Selective solvents also improve the color and carbon residue and lower viscosity and specific gravity of the oil. The pour point is often raised because of concentration of wax in the raffinate phase.

Dewaxing solvents are used for removing wax which affects the pour point of the oil. This may have certain effects on viscosity and gravity of the product and on some other tests caused by elimination of this material which might be regarded in some respects as a diluent.

Flash and fire points remain substantially unchanged after solvent refining because in most instances they are very little affected by the removal of asphalt, wax or low viscosity index materials. However, determination of the flash point is often desirable for estimating completeness of solvent removal or the possible loss of light oil fractions on distilling off the solvent.



Air view of a modern solvent lube oil plant, showing duo-sol refining unit at left, furfural refining unit in the center, and MEK dewaxing unit at right. All were designed and built by Lummus Co.

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Open $500,000 Coal Gasification Pilot Plant

RESEARCH on synthetic liquid fuels moved another step forward last month with the opening at Library, Pa., of new pilot plant facilities for studying the gasification of coal to produce a suitable synthesis gas.

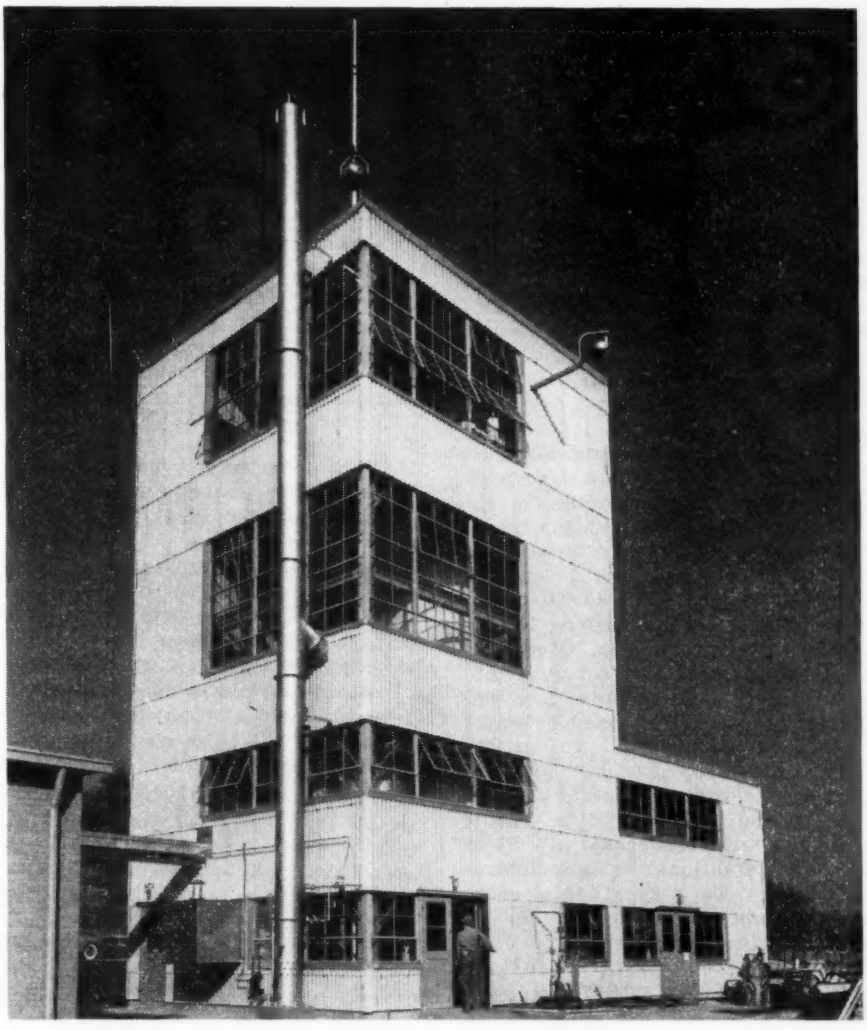
The plant, designed and built by Pittsburgh Consolidation Coal Co. in cooperation with Standard Oil Development Co. at a cost of more than $500,000, is the biggest step yet taken by the two firms in a joint research project on synthetic liquid fuels, a project announced early in 1947.* It employs SOD's well-known fluidized solids technique and will be run to study the operability of the fluidized coal gasification process in order to reach conclusions regarding costs and commercial designs.

Included in the pilot plant are a control building, the process building (shown in the accompanying photograph), and a combination shop and store room. The process equipment is extensively instrumented for control and safety. Operations are conducted by a staff of 50 people on a continuous basis.

Operation of the plant is in the hands of Pittsburgh Consolidation's Research and Development Division, which was established early in 1947 just about the time that the joint research project with SOD was made public. At that time it was reported that one of the major assignments of the new division was to be the study and development of more efficient coal gasification processes.

Contract for construction of the pilot plant was let in August, 1947, to the Chemical Plants Division of Blaw-Knox Co. Actual work on the site was begun by Blaw-Knox on March 8 of this year, and the completed installation was turned over to P-C's Research and Development Division Oct. 10. Formal opening of the facilities was held Nov. 15.

P-C has made no recent statements about the size of the gasification pilot plant. When the plans were first announced, however, the company stated that about 50 tons of coal a day would be consumed, which was expected to yield around 2,400,000 cu. ft. of gas suitable for synthesis work, nearly 50,000 cu. ft. per ton. More recently company engineers told PETROLEUM PROCESSING that the plant would be able to handle from 100 to 150 lbs. of coal an hour, less than two tons a day.



View of the process building of Pittsburgh Consolidation's new coal gasification pilot plant at Library, Pa., designed and built in co-operation with Standard Oil Development Co. at a cost of more than $500,000. This building houses the generator, in which powdered coal or char is reacted with steam and oxygen, using SOD's well-known fluidized solids technique

Another phase of P-C's research operations which ties in with the work on synthesis gas is coal carbonization. When heated to about 800° F. or above, coal is converted by carbonization into a granular char-like residue, a tar, and a gas of high-heating value. The char is highly reactive and is almost equal in heating value per pound to the original coal. Both coal and char will be used as raw material for the new gasification pilot plant.

Commenting on what was expected from the new pilot plant, George H. Love, president of P-C, said:

"At present there is no apparent economic justification for the investment of large sums in commercial facilities to convert coal into gasoline. But we must anticipate that the time will come when such conversions will be commercially justified, or necessary in the national interest.

"While growing energy demands are expected to increase the use of coal in solid form, establishment of new uses will add security to the industry's future. These things—to be ready for a national need, and to establish new markets for coal—are the objectives of our research, which we can't leave to others to do."

* For earlier stories on the P-C and SOD project see PETROLEUM PROCESSING for May, 1947 (pg. 325), "Processing Coal into Liquid Products May Be Practicable in a Few Years;" and for August, 1948 (pg. 739), "Coal-to-Oil Plants Loom Closer"

Gasoline and Cycling Plant Operation

Conducted by DAVE THORNTON

Data in answer to Questions is supplied through the cooperation of engineering authorities with companies of the Natural Gasoline Supply Mens Assn. Readers are invited to submit questions on their own plant operating problems.

What are the most frequent difficulties noted with gas compressors and how can these be avoided?*

The modern compressors and engines are much less bulky, more compact, better balanced, more efficient and much less demanding in attention and maintenance than the early ones. They are so reliable this leads to neglect and abuse, such that repetition of a few well-known warnings seems well justified.

There always is some soot and dust present in the atmosphere. No matter how low the contamination, the cumulative effect over days, weeks and months can be very serious, especially when considered in conjunction with the fact that 40,000 cu. ft. of air goes through a modern 300 hp. 4 cycle gas engine hourly. Moreover, due to the turbulent effect built into most modern engines, any dust will be thrown onto the cylinder walls, where it is held by the oily surface. The result is an excellent grinding compound, causing excessive wear to rings, pistons and cylinders. Some of it gets into the crankcase oil to set off an additional chain of harmful effects. To prevent this, clean air inlet pipes carefully, use an efficient air filter, and service the filter frequently.

Often the above precautions are well observed but no attention is paid to fuel gas or piping. Consequently dust, pipe scale, welding beads and the like are fed to the engine with the fuel gas. The damage may be even more rapid and severe than with open air intake lines.

We frequently have been called to new installations with the complaint that, after a few days of operation, the engines would not carry the load. We found the screens in the fuel lines to the mixing valves clogged with dirt, starving the engine. How much dirt meanwhile passed through the screens and was grinding the life out of the engine was difficult to estimate. It is much less expensive than worn cylinders, etc., to clean all gas lines thoroughly. If you are not certain the gas will be clean, install fuel gas filters.

Abnormal amounts of dirt fed through compressor cylinders, particularly during starting up periods, is another common and sorry occurrence.

The importance of keeping power cylinder jackets free from deposits and scale is frequently not appreciated. The argument often is advanced that scale deposits were only 1/16 in. thick and certainly could not have caused the trouble experienced. Actually, a much thinner layer could be exceedingly harmful.

Some years ago *Diesel Power* and *Diesel Transportation* published data to the effect that 1/16 in. of calcium carbonate scale had the heat transfer equivalent to 4¼ in. of cast iron, and the same thickness of silicate scale was equivalent to 14⅞ in. of cast iron. While not vouching for the accuracy of these figures, they certainly explain many things which have happened in the past and dictate the urgency of avoiding scale deposits in cylinder jackets.—J. J. Janzen and Drew T. Whiting, Ingersoll-Rand Co.

What is the best method of heating well-head gas to prevent gathering line stoppage by hydrate formation?

This subject can be divided into two parts: "Heating prior to initial separation", and "heating along the gathering system."

The amount of water and condensable hydrocarbons remaining in the vapor phase after passing through the separator depends upon its operating pressure and temperature. The optimum first-stage operating pressure for maximum fluid recovery for most high gas-oil ratio wells is in the range of 700 to 900 psi at a temperature of about 5° F. above the hydrate expectancy point, which in this case is about 63 to 67° F. Since the well head flowing pressure is generally much higher than the optimum separation pressure, it is necessary to incorporate into the system some type of pressure reduction station.

Because pressure reduction is attended by flow stream cooling, one of the necessary components of the station is some method of adding sufficient heat to the flow stream to maintain its temperature above the hydrate point. In connection with this pressure reduction from well head to separator arises one of the common errors in the operation of high pressure wells. Some operators, in attempting to gain greater safety in their production practices, attempt to take a considerable portion of the

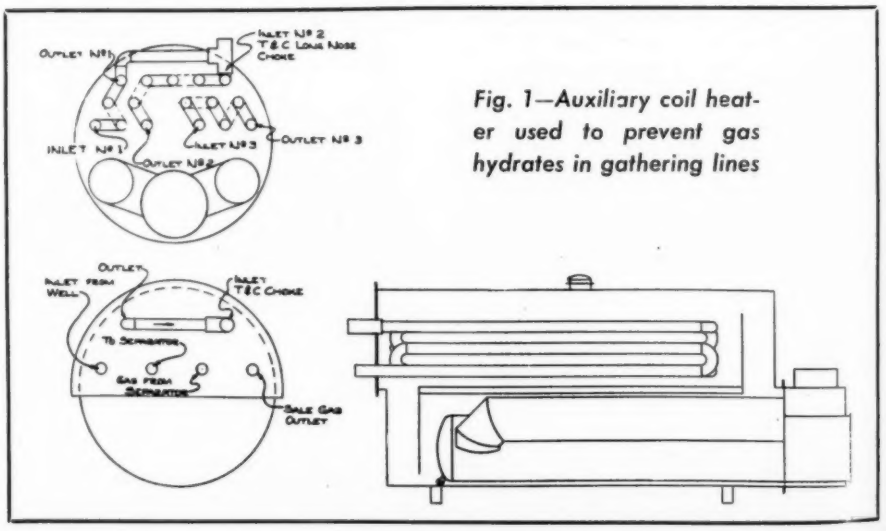
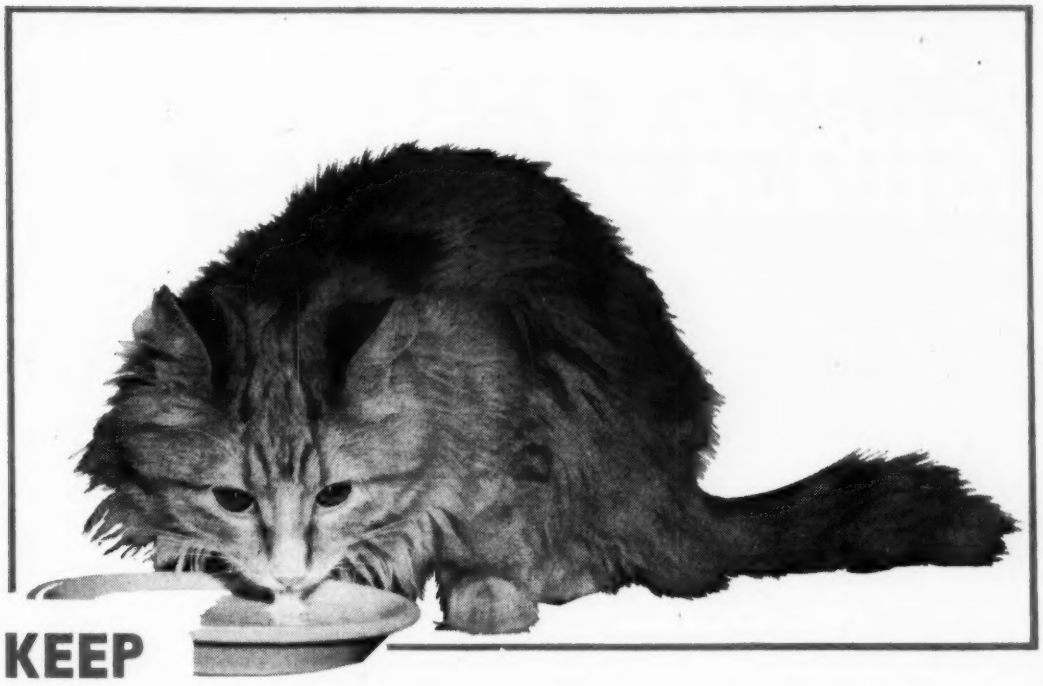


Fig. 1—Auxiliary coil heater used to prevent gas hydrates in gathering lines

* Suggested by the paper "Short History of Compressors in the Natural Gasoline Industry and Some ABC Operating Rules," presented at the Shreveport regional meeting, Natural Gasoline Assn. of America, Oct. 15—D.T.



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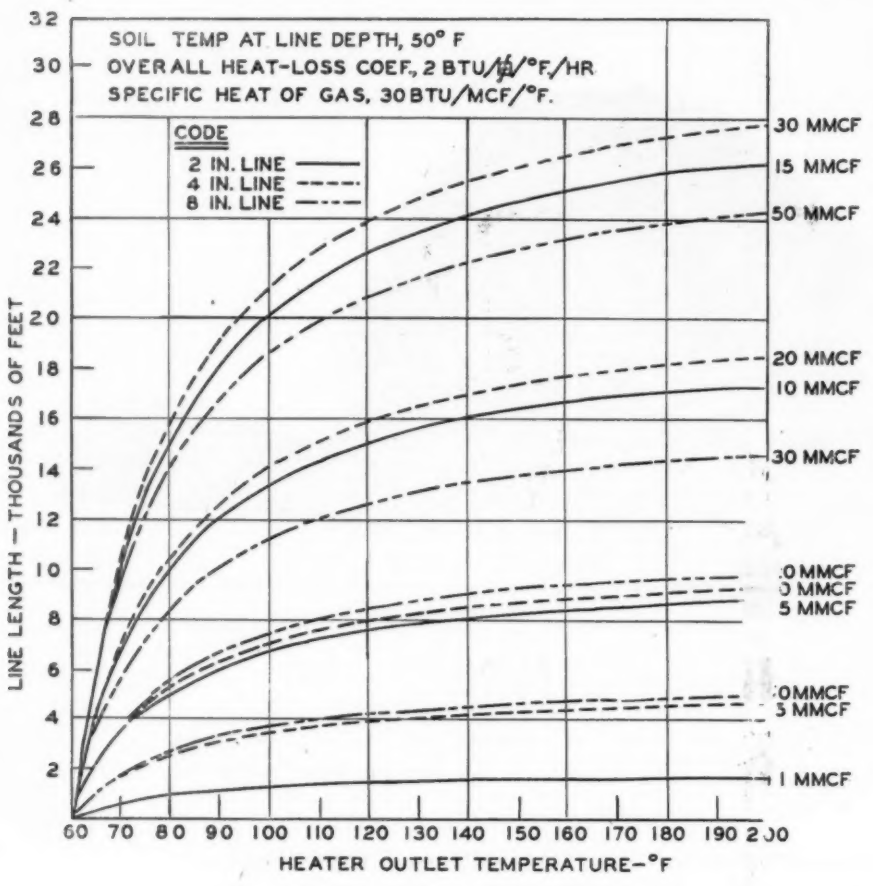

Fig. 2—Heater outlet temperatures for various line sizes, gas volumes, and heater spacings

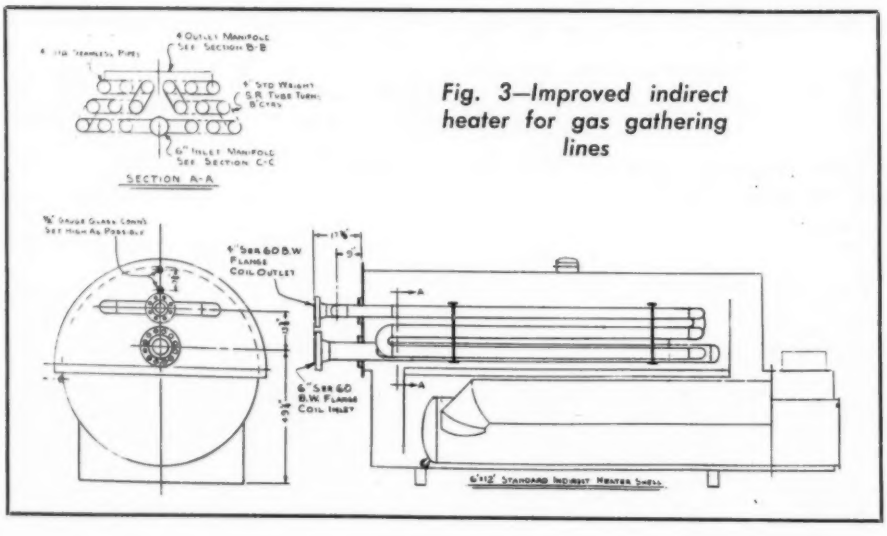

Fig. 3—Improved indirect heater for gas gathering lines

pressure reduction at the well head, so in event of surface equipment failure the well will not blow open to the air.

However, the temperature reduction resulting from choking at this point often results in extreme weather in freezing between the well head and the main pressure reduction station. Experience has shown that the best method of operation, if additional safety is desired, is to set the well head choke so there is little or no temperature drop across it. However, such a choke setting still affords considerable safety in case of flow line failure.

Another consideration, often overlooked, is whether heating should take place before or after expansion. It requires less surface in the gas heating coil if the heating is made after expansion, due to the greater mean temperature difference between the gas and water bath. In case of long flow lines, a preheat coil should be placed ahead of the choke to prevent hydrates from stacking up on the seat of the choke.

In the above setup, the gas leaves the separator just slightly above the hydrate point. Therefore, to be able to transmit the gas any appreciable distance its temperature must be increased. The best present method of doing this job is by use of an auxiliary coil in the heater. Such a heater is shown schematically in Fig. 1.

In order to facilitate the selection of transmission line heaters, we have plotted the calculated results of a rough heat balance for various line sizes, gas volumes, and ground temperatures.

Heat Balance:

$$V_g C_p (T_i - T_o) = HLA \left(\frac{T_i - T_g + T_o - T_g}{2} \right)$$

Where

V_g = gas volume mcf./hr.
C_p = specific heat BTU/mcf./°F.
H = overall pipe-to-soil heat loss coefficient, with the value of H for various soil conditions being as follows: swamp, 2.5; swampy ground, 2.0; moist heavy soil, 1.5; light sandy loam or sand (dry to slightly moist), 1.0; volcanic ash soil (dry), 0.5.
L = line length, ft.
A = sq. ft. of line surface per ft.
T_i = inlet temperature.
T_o = outlet temperature.
T_g = ground temperature at line depth.

Although the plots, Fig. 2, were originally made for spacing line heaters, they also show quite remarkably the economic temperatures to which gas can be heated for transmission and the marked effect of line size on heater spacing for a fixed amount of gas.

If restrictions are eliminated from the gathering system more satisfactory operation can be obtained. In line with this, a heater design has been worked out by a Louisiana operator which is receiving quite wide acceptance. As shown in Fig. 3 the gas entry into the heater is through a large diameter tube, to eliminate the sharp reduction from flow line to heater coil size. This Y's into two banks of smaller coils manifolded together at the outlet. The purpose of the large coil is to receive hydrates from the system which might, and probably do, arrive at the heater in slugs and allow them to melt before passing on through the heater.—J. L. Maher, National Tank Co., Tulsa (From a discussion presented at N.G.A.A., Shreveport, Oct. 15.)

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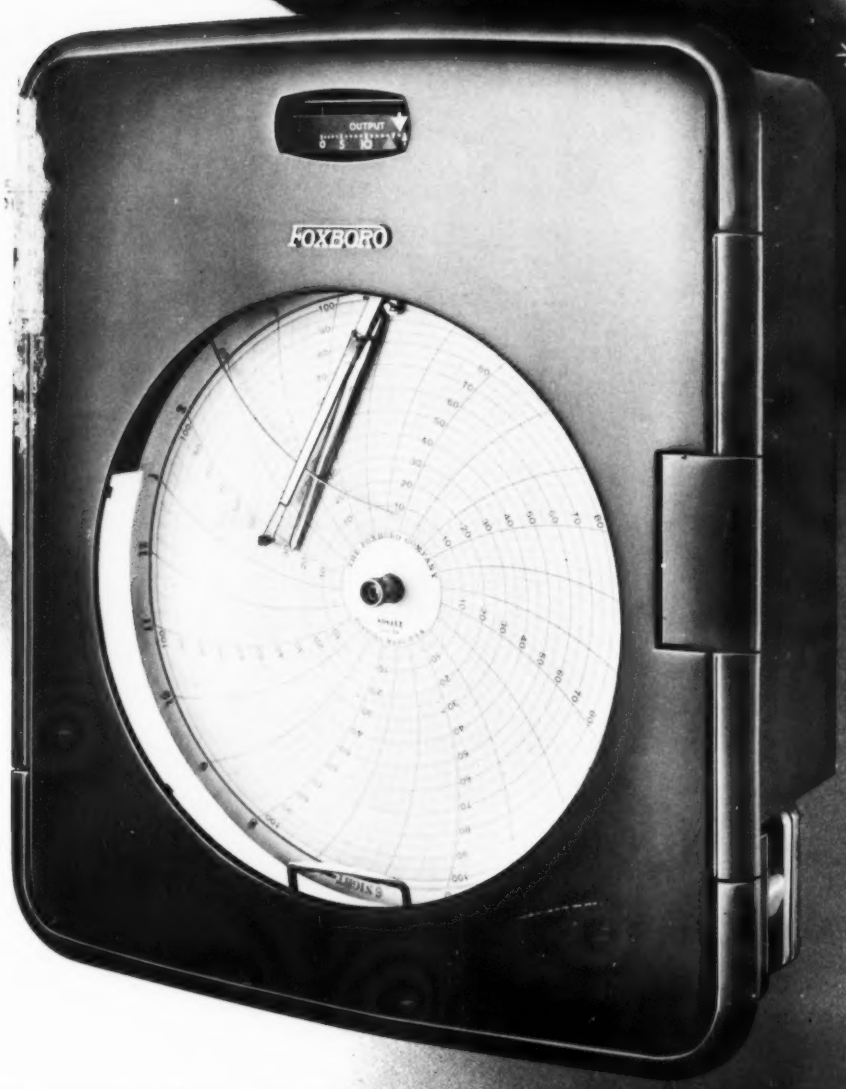

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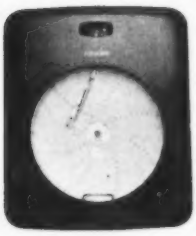

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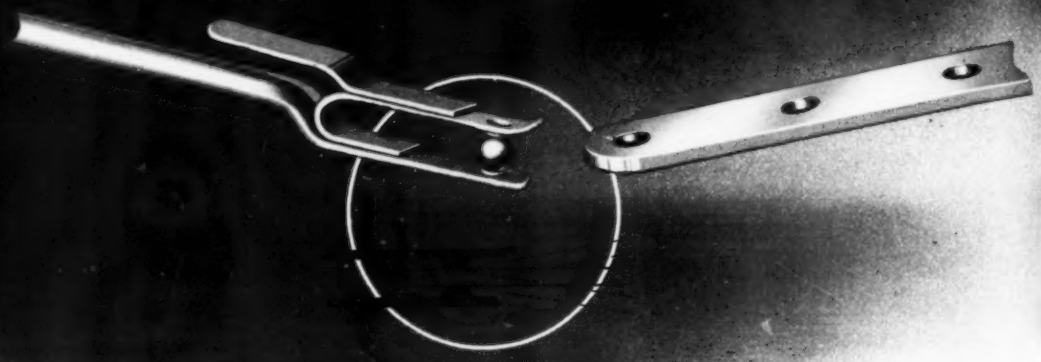

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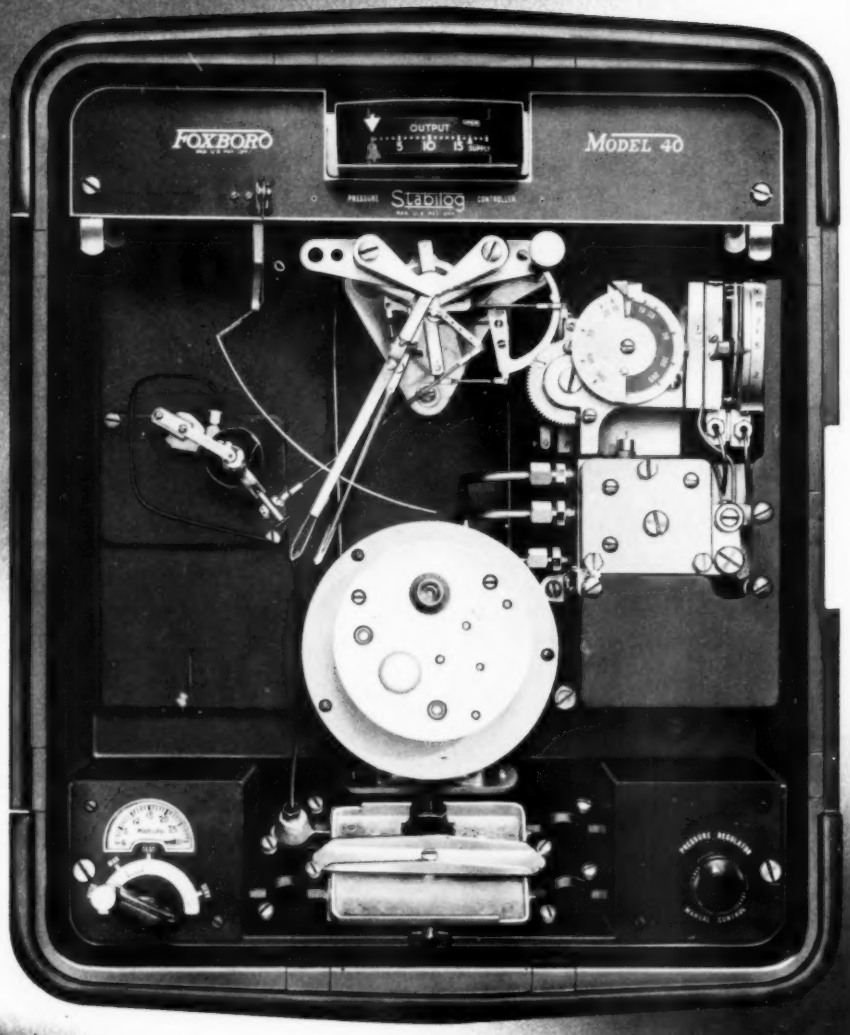

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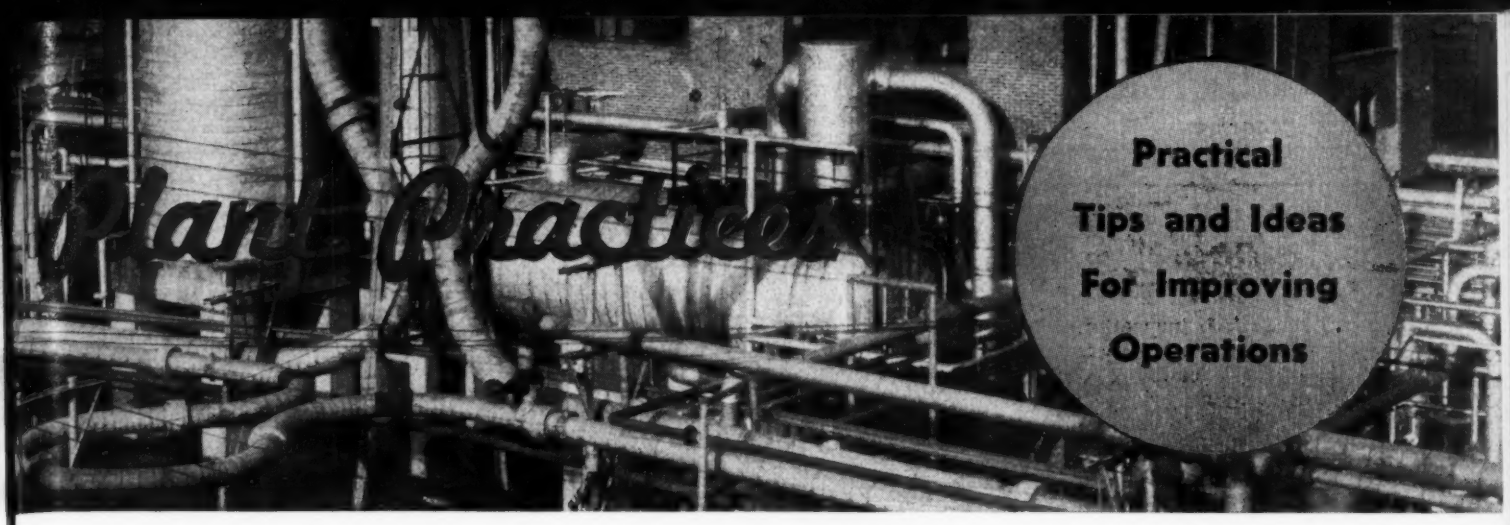


Special "Sky Hooks" Make Painting Safe On Weak and Corroded Refinery Stacks

PAINTERS at the East Chicago refinery of Sinclair Refining Co. now approach stack painting jobs with complete feeling of confidence and safety because they are using special "sky hooks" of their own design.

As shown in Fig. 1, the sky hook consists of a piece of pipe, 1½-in. in diameter, with a U-shaped hook of approximately 1 ft. radius formed at one end. The straight section in the device shown is about 14 ft. long, but the crew has a complete set of such hooks of various lengths and sizes for different stacks.

Mounted on couplings along the straight section of pipe are three loops, or rings, of ½-in. rod. One ring is near the hook end, the second about 3 ft. below it, and the third one at the bottom end.

In use, the sky hook is hoisted up the stack by a line fastened to the middle ring and running up and over the permanently-installed pulley near the top of the stack. This hoisting halyard, along with another line fastened to the lowest ring, serves to guide the hook up and over the top rim of the stack to be painted. A third line, pulley, or whatever is needed, is already hooked in place on the top ring of the sky hook for supporting the painters' Bo'suns' chair.

Once the hook is in place it can be lashed securely to prevent sidesway. The painter then works the stack from top to bottom, moving his hook and scaffold arrangement around it in easy stages.

The Sinclair painters decided to devise this safety sky hook because some old stacks were so badly corroded that the permanent bracket and pulley couldn't be trusted to support the weight of a workman. With the new hooks, if the stack metal does give way in some spots, the hook will merely slide down a few inches until it meets solid metal.

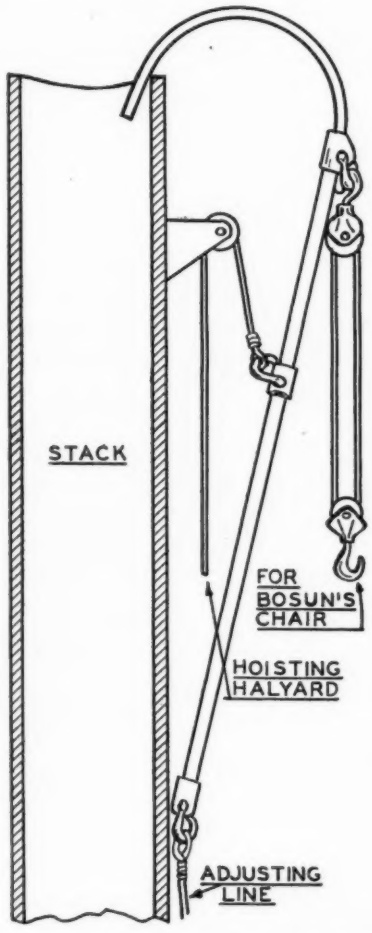


Fig. 1—Method of using "sky hook" for painting refinery stack

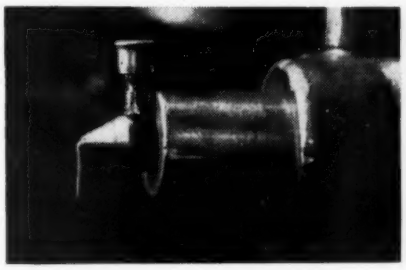
Handy Grease Cup Fitting Prevents Wear On Machine Lathe Tail-stock Center Bar

By JOHN C. ALBRIGHT

MACHINISTS operating lathes in refinery maintenance shops all find sooner or later that the tail-stock center bar must be replaced or at least reconditioned, due to the wear caused by friction between the bar and the piece on the lathe, for example, a pump piston rod. A few drops of machine oil will lubricate the bearing surfaces, but the film strength of such a lubricant is sometimes not great enough to prevent wear.

Adequate lubrication can be obtained by using a heavy grease. As worked out by Chief Machinist R. O. Walling at the Alma, Michigan, refinery of Leonard Refineries, Inc., this is accomplished by fitting an ordinary compression grease cup to the center bar as a means for feeding lubricant to the wearing surfaces. The finished fitting is shown in the photograph.

The fitting is made in this way: The center bar is chucked in a vise on the bed of a post drill and a wire gage hole is drilled precisely in the center of the pointed tip. The size of this hole is not important as long as it is large enough to allow heavy grease to pass through.

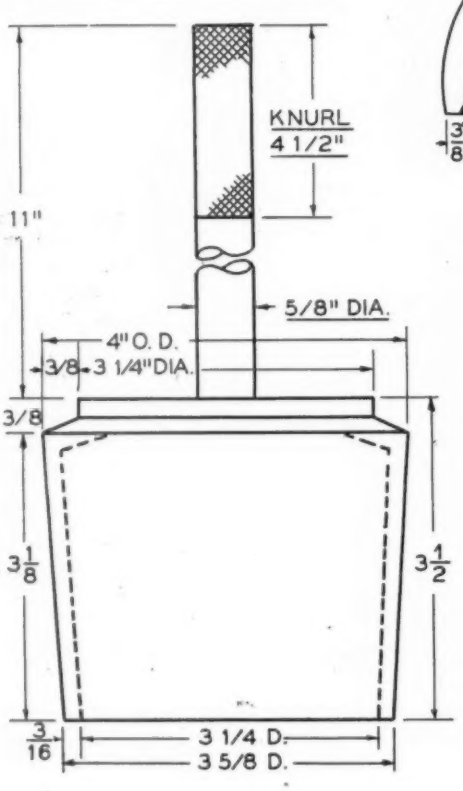


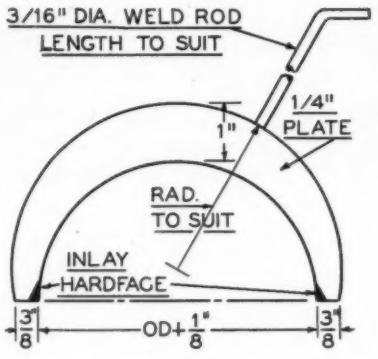
String-like object hanging from center-bar tip is grease forced through from compression cup

Next, a hole is drilled through the side of the bar to connect with the axial hole. This second hole is large enough to accommodate a 1/8-in. pipe tap so as to form threads for attaching the grease cup. In order to keep the cup out of the way of work on the lathe, a short nipple and a collar serves as a riser. An occasional twist of the cup forces enough grease to the bearing surfaces to afford adequate lubrication.

"Wobble" Gages Speed Up Inspection

PHYSICAL inspection of various tubes in process equipment at Socony-Vacuum Oil Co.'s East Chicago refinery has been made faster through a number of standard "wobble" gages developed and made by the refinery engineering department. Two of the gages are shown in the accompanying sketches. They are made in various sizes as determined by the size tube to be inspected. The drawing on the left illustrates a wobble gage used for determining "lipping" of the roll in polyforming unit tubes, 5 in. O.D., ⅝ in. wall thickness. In using the device, the inspector inserts it in the end of the tube. If it wobbles, he knows lipping has occurred. The drawing on the right shows an external type of wobble gage for checking swelling of furnace tubes. As indicated, its inside diameter is made equal to the furnace tube O.D. plus ⅛ in.





Build Inexpensive Cooling Water Treater From Ordinary Drum, Pipe and Fittings

By E. H. MEHLBURGER, Superintendent
American Mineral Spirits Co., Corpus Christi, Texas

A simple means for proportioning water-treating chemical into the cooling tower basin as used at the American Mineral Spirits Co., Corpus Christi, plant requires only a 55-gal. galvanized steel drum, short lengths of steel pipe and copper tubing, and a plug valve.

Illustrated in Fig. 2, a piece of ½-in. pipe is welded into the side of the steel drum near the bottom. The pipe has a kink in it to act as an air trap. A short piece of ¼-in. copper tubing is welded into the small bunghole on what is now the top of the drum. This tube is bent through a 180° arc at its free and open end, and also carries a small plug cock. In a near-by tank or open-top drum (not shown) water treating chemical is mixed at a ratio of 1 lb. chemical to 1 gal. water, using steam to agitate.

Once each day the ½-in pipe at the bottom of the drum is capped. A predetermined number of gallons of the mixed chemical solution is transferred to the drum through the larger opening in the top. The drum is filled with water and capped.

After the cap is removed from the ½-in. pipe, the plug cock in the ¼-in. tube is adjusted to admit enough air into the drum so as to maintain a stream approximately 350 to 400 cc./min. flowing into the cooling tower basin. Naturally the stream will slow down as the drum empties itself, but the plug cock can be adjusted if desired so the total flow time for one drum-full of solution is 24 hours.

The device is simple, inexpensive, and requires a minimum of attention. Once the cock has been adjusted, it need never be changed. The quantity of treating chemical, of course, is determined by periodic analyses of the cooling water.

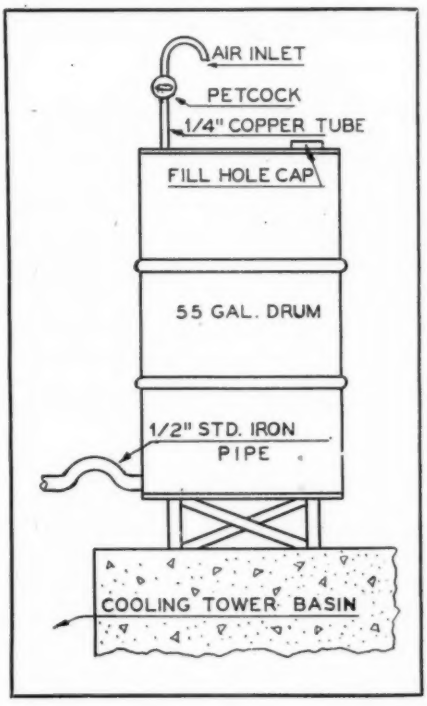


Fig. 2—Cooling water treating chemical is fed into basin by inexpensive proportioner made from an ordinary steel drum

IDEAS—Wanted!

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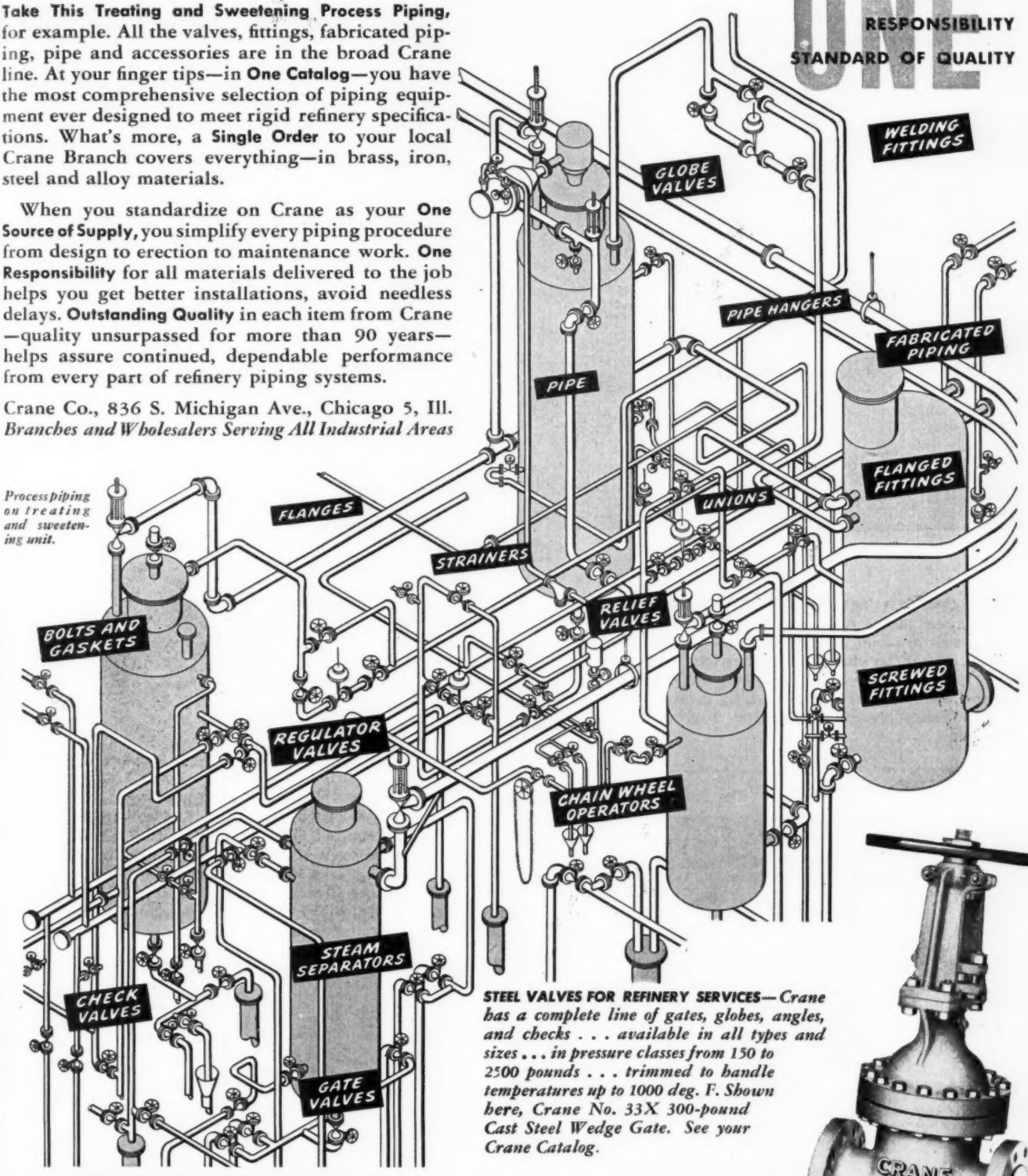
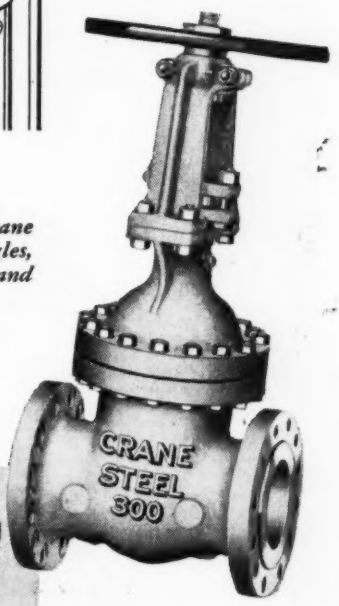


Process piping on treating and sweetening unit.



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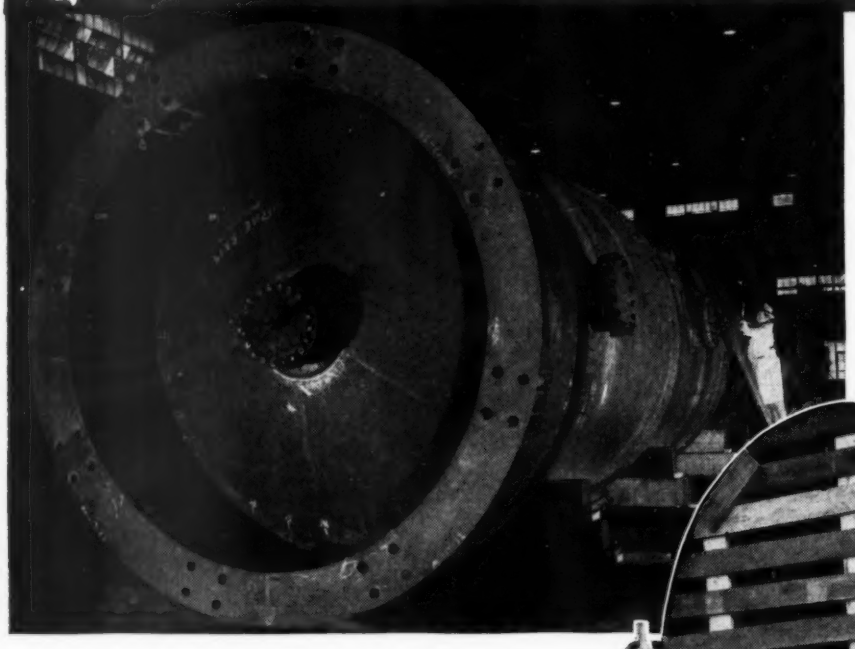
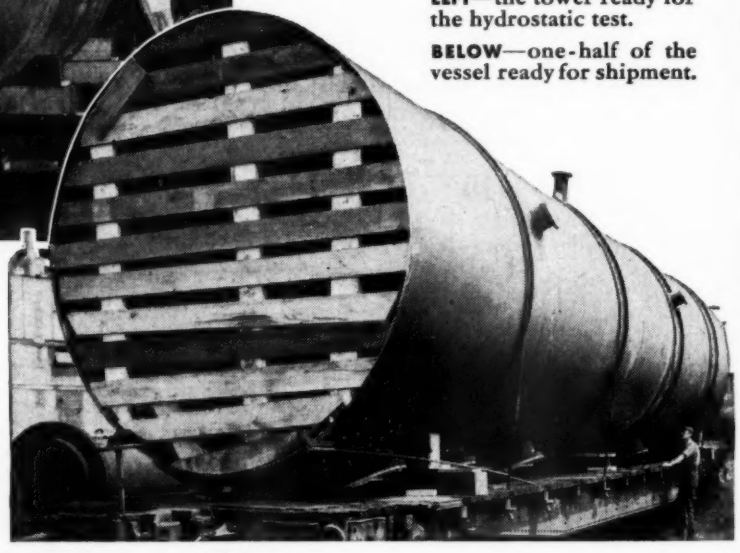


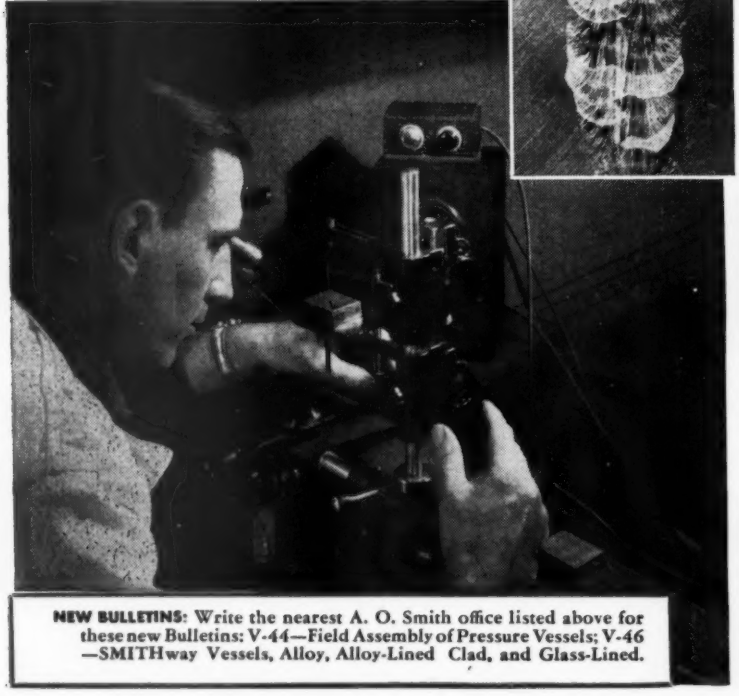
A. O. SMITH TAKES THE GUESS WORK OUT OF FIELD ASSEMBLY. Railroad shipping restrictions made it necessary to field-assemble this 11½ ft. dia. x 116 ft. long SMITHlined Fractionating Tower. To insure ease of assembly in the field, it was first manufactured and completely assembled in the A. O. Smith Milwaukee Plant, then hydrostatically tested, cut in two at the center girth seam, rescarfed for welding in the field, and shipped. Field-assembly costs were cut to a minimum with only one girth seam to be welded.

LEFT—the tower ready for the hydrostatic test.

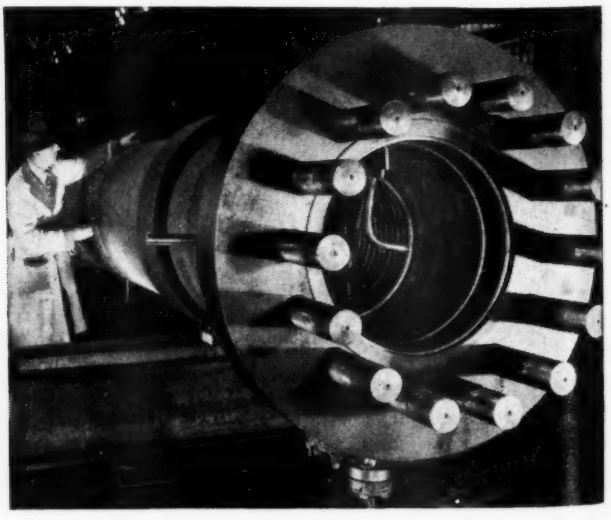
BELOW—one-half of the vessel ready for shipment.



MANY TESTS BEYOND CODE REQUIREMENTS are a regular part of A. O. Smith vessel production control procedures. Here Bill Poehlman, a 20-year veteran, in charge of spectroscopy and X-Ray research, checks the deposited weld metal composition in a vessel test plate, by means of an A. O. Smith-developed microspectrographic technique.



IN STOCKHOLM, SWEDEN, they know about the famous SMITHway welded Multi-Layer vessel construction. Here is one of two SMITHway Inconel-lined Multi-Layer Autoclaves for fatty acid service, with a shell thickness of 5 inches and an operating pressure of over 5,000 psi. This vessel was shipped direct by ocean-going ship from Milwaukee to Stockholm.



NEW BULLETINS: Write the nearest A. O. Smith office listed above for these new Bulletins: V-44—Field Assembly of Pressure Vessels; V-46—SMITHway Vessels, Alloy, Alloy-Lined Clad, and Glass-Lined.

Direct Titration Method Gives Fast, Accurate Determination of Salt Content of Crude Oils

DIRECT determination of salt in crude oil by electrometric titration has been developed as a rapid and accurate technique which does not require preliminary water extraction, with all its attendant objections such as need for skilled operators and the length of time required.

The method was described by R. E. Dickey and L. V. Sorg, Standard Oil Co. (Indiana), Sugar Creek, Mo., in their paper, "The Determination of Inorganic Chlorides in Crude Oils by Direct Electrometric Titration," presented before the Petroleum Division of the American Chemical Society during its 114th meeting at St. Louis, Sept. 6-10.

Any good electronic voltmeter equipped with glass electrodes and a silver electrode may be used; Dickey and Sorg prefer the Precision-Shell Dual Titrometer and shielded high-resistance electrodes. With the dual instrument, two routine determinations may be carried out simultaneously in 15 to 20 minutes.

Other equipment includes two 10-ml. microburettes, special ground-top 250-ml titration beakers, 1-, 2-, 5- and 10-ml. transfer pipettes and a 100-ml. graduated cylinder. Reagents required are:

0.0100 N. silver nitrate in 90% isopropyl alcohol.

Organic electrolyte—600 ml. CP benzene, 400 ml. CP isopropyl alcohol (98-99%) and 6.7 ml. of 68% HNO_3.

Wash solution—500 ml. CP benzene and 500 ml. isopropyl alcohol (98-99%).

Sample sizes depend upon the amount of sodium chloride expected and, in the case of "new" crudes, a preliminary determination is recommended to ascertain the proper size of sample to be used. Table 1 gives the approximate volumes required with various salt contents.

Preparation of Equipment

The titrometer is adjusted as recommended by the manufacturer. The system is adjusted to read zero when the electrodes are immersed in distilled water. The electrode system then is flushed off with the benzene-isopropyl alcohol wash solution and immersed in the sample. When the titration is completed, the electrodes should be thoroughly rinsed with the wash solution and then with distilled water. The electrodes always should be immersed in distilled water when not in use and the silver electrode may require polishing occasionally with Crocus cloth.

The titration beaker is prepared by introducing 100 ml. of the organic electrolyte, followed by the appropriate volume of sample. Sediment adhering to the transfer pipette is rinsed into the beaker by drawing several portions of the electrolyte solution from the beaker into the pipette. The stirrer is adjusted to give good agitation without splashing. The burette, filled with 0.01 N. $AgNO_3$, is adjusted to zero.

The titrometer is adjusted to the negative millivolt range, and the range-selector switch positioned to bring the needle on the scale. The initial millivolt reading is recorded. If greater than −400 mv., hydrogen sulfide is probably present. If less than −400 mv., the reverse is true and no unusual precautions for adding silver nitrate are necessary.

Assuming a reading of −400 mv. or more is obtained; 0.1 ml. increments of reagent should be used until the change in millivolts per increment approaches 20, shifting to increments of 0.05 ml. until the "break point" is passed. The change then will tend to drop off and larger increments—up to 0.5 ml.—can be used without exceeding the 20 mv. limitation. Record the volume of titrating reagent, hereafter called "reagent," up through the "break point."

If the reading is less than −400 mv., initial increments of 0.5 ml. of reagent may be used, recording the data after equilibrium has been reestablished following addition of each increment of reagent, until a change of about 20 mv. per increment indicates that additions be decreased to 0.25 ml. and, subsequently, to 0.1 and 0.05 ml. as the "break point" is approached. After the "break point" is passed, indicated by an appreciably smaller millivolt change per increment of reagent added, discontinue the titration. Record the total volume of reagent used up through the "break point," including that used for titrating hydrogen sulfide, if any.

When a West Texas crude is the sample, the magnitude of the inflection obtained by plotting millivolts vs. volume of reagent is typically

TABLE 1—Size of Sample

Lbs. NaCl (est'd.) 1000 bbls. crude	Sample, ml.
0-150	10
150-300	5
300-1000	2
Above 1000	1

TABLE 2 — Conversion of Standard Reagent

Size of Sample, ml.	Lbs. NaCl/1,000 Bbls. ml. 0.0100 N. $AgNO_3$
10	20.5
5	41.0
2	102.5
1	205.0

TABLE 3—Inorganic Chloride Content of Crudes as Determined by Direct Electrometric Titration and by Water Extraction

ORIGIN OF CRUDE OIL	H_2S Present	Salt calculated as lbs. NaCl/1,000 bbls. —Electrometric— Run 1	—Electrometric— Run 2	—Extraction— Run 1	—Extraction— Run 2
Typical mixed Midcontinent	No	86	86	92	75
Typical mixed Midcontinent	No	21	22	25	17
Typical mixed Gulf Coast	No	41	41	42	42
Typical mixed Gulf Coast	No	69	69	71	63
Typical mixed West Texas	Yes	195	191	180	116
Typical mixed West Texas	Yes	236	232	213	209
From West Texas Wells:					
Anton	No	19	13	13	13
Levelland	No	1640	1618	1460	1433
PHD	Yes	77	80	88	84
Yellowhouse	Yes	123	125	121	134
Irish	No	26	25	29	25
From Kansas Wells:					
Robbins Field	No	38	38	46	50
Burrton	No	18	19	21	17
Saundra	Yes	293	300	314	309
From Oklahoma Wells:					
Oscar	No	158	155	163	167
Healdton	No	61	63	71	71
From Wyoming Wells:					
Steamboat Butte (Tensleep)	No	0	0	4	4
Gebo	Yes	10	10	17	17
Salt Creek Light	No	3	2	4	8
From Gulf Coast Wells:					
Anahuac	No	27	25	38	38
Conroe	No	22	24	33	33
Old Ocean	No	0	0	4	4
From East Texas Wells:					
Hawkins	No	1275	1322	1223	1303
Merigale	No	30	31	33	38
Van	No	312	316	376	372

Model S

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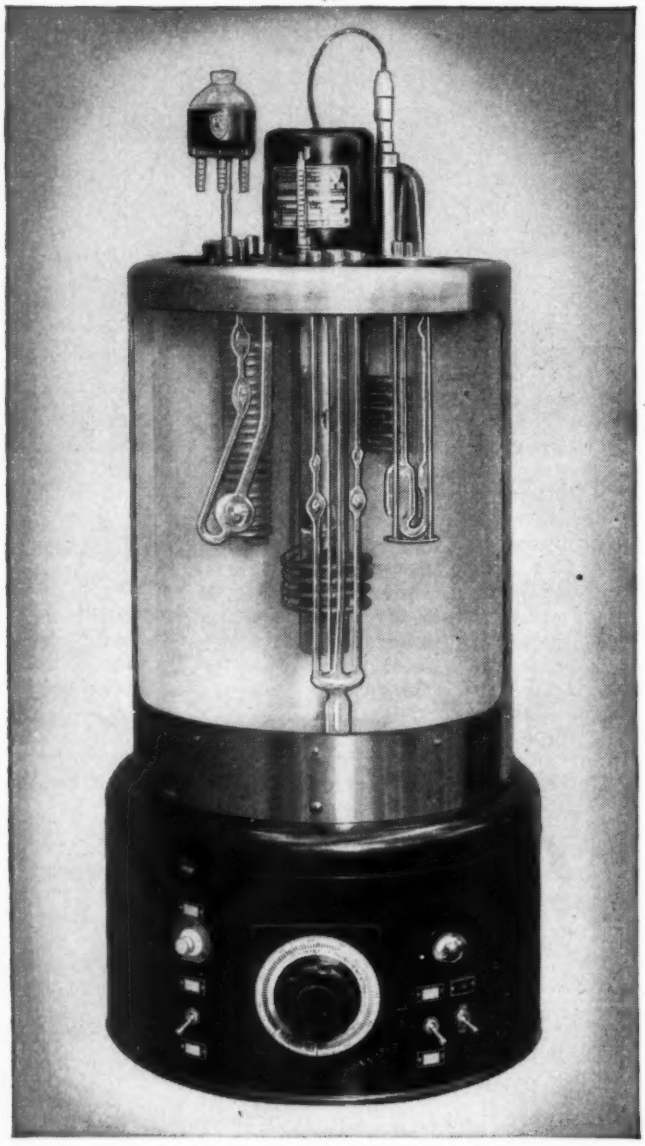

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less than that observed for most other crudes. In this case the size of the increments used should be as previously recommended. However, the change to successively smaller increments should be made on a 10 mv. per increment basis, rather than 20 mv.

Where "A" is equal to the total volume in milliliters of standard $AgNO_3$ solution used to reach the chloride end-point, and "B" equals the volume used to reach the hydrogen sulfide end-point, the total chlorides (expressed as lbs. NaCl per 1000 bbls. of crude) is:

$$(A-B)\ (\text{Normality of } AgNO_3) \times 0.0585 \times 3785 \times 42 \times 1000 / (\text{ml. sample}) \times 454$$

when: 0.0585 = g. of NaCl equivalent to 1 ml. standard $AgNO_3$ solution, 3785 = number of milliliters in a U. S. gal., 42 = number of gallons per barrel and 454 = number of grams in 1 lb.

A conversion table for converting milliliters of standard silver nitrate solution to pounds of salt per 1000 bbls., when the standard solution is exactly 0.0100 N., is given in Table 2.

Silver nitrate may react with other compounds besides inorganic chlorides found in crude oil. Most probably these will be inorganic sulfides and mercaptans. The effect was determined by adding about 1 mg. H_2S per 100 ml. of Mid-Continent crude which had previously been analyzed by this method. It was found the H_2S was precipitated first by the titrating reagent, to give a very sharp inflection point. The remainder of the titration was normal and gave a good chloride inflection point.

Likewise, to a portion of the same sample containing H_2S, 0.1% of amyl mercaptan was added. Although the chloride inflection occurs before that of the mercaptans, the mercaptans appear to reduce the sharpness of the chloride end-point. Based on this experimental addition, it is concluded that if more than about 0.2% of mercaptan is present, the chloride inflection point will be sufficiently obscured to make this method of analysis valueless. However, with oil containing less than 0.2% mercaptans, no adverse effect on the chloride titration has been observed.

Precision of the method has been found within 1.5% average deviation on all samples tested. In experiments where known quantities of 0.500 N. lithium chloride solution in 99% ethanol was added to crudes either containing no inorganic chlorides or known quantities, the average deviation was found to be 2.7% by direct electrometic and 4.7% by water extraction procedures. Precision in analyzing known quantities of lithium chloride in the pure organic electrolyte was found to average 0.42%.

Analyses of a number of crude oils by water extraction and direct titration methods are given in Table 3. Experience with the direct electrometric method indicates that its precision is considerably better than obtainable with any of the conventional water-extraction methods with which it has been tried. On routine samples containing between 0 and 300 lbs. of inorganic chlorides (calculated as NaCl) per 1000 bbls., an overall accuracy of 5 lbs. per 1000 bbls. can be expected, and most determinations will have an accuracy between 2 to 3 lbs.

Flexible Coupling Is Disconnected Quickly, Facilitates Aligning Test Engine Shafts

A home-made flexible coupling has been developed by technicians at the engine test laboratory of Monsanto Chemical Co., St. Louis, to take care of an unusual flexibility and vibration dampening requirement in connecting Chevrolet test engines to loading dynamometers. The coupling consists of three ½-in. thick discs of heavy industrial cloth and the necessary spacers between dynamometer shaft flange and the engine shaft flange.

Two ½-in. bolts 180° apart connect the first disc to the engine shaft through the required spacer, and two more, 90° away from the first, connect this disc to the next, and so on until connection to the dynamometer shaft flange is completed. (see Fig. 1.)

With this arrangement the engine can be mis-aligned several thousandths of an inch from the "true" position and still develop no undue strain on either the engine crankshaft or dynamometer shaft. To connect or disconnect the engine from the shaft, only two bolts need be touched.

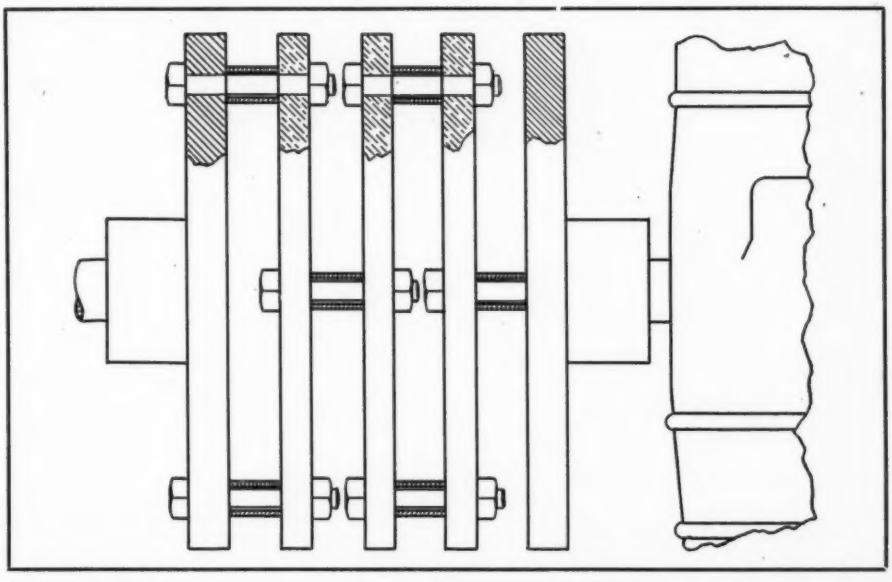
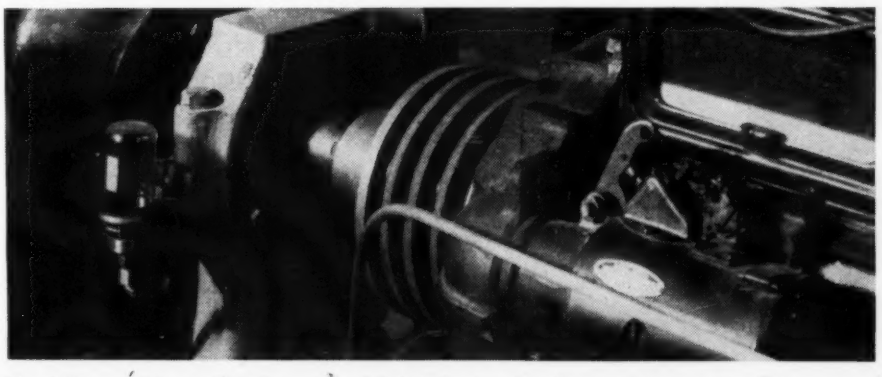


Fig. 1—Partial cross section of special coupling shows use of interconnecting ½-in. bolts



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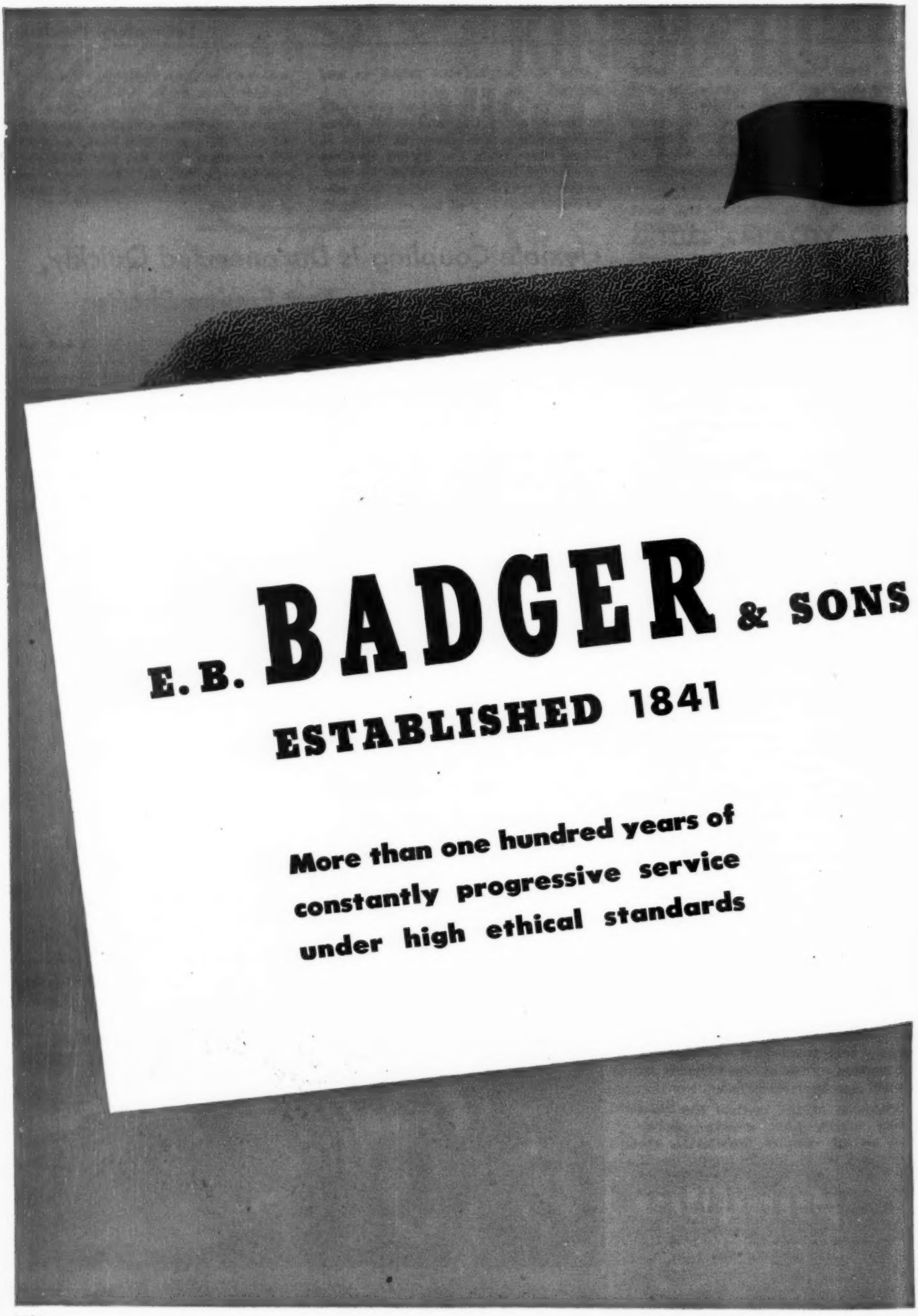
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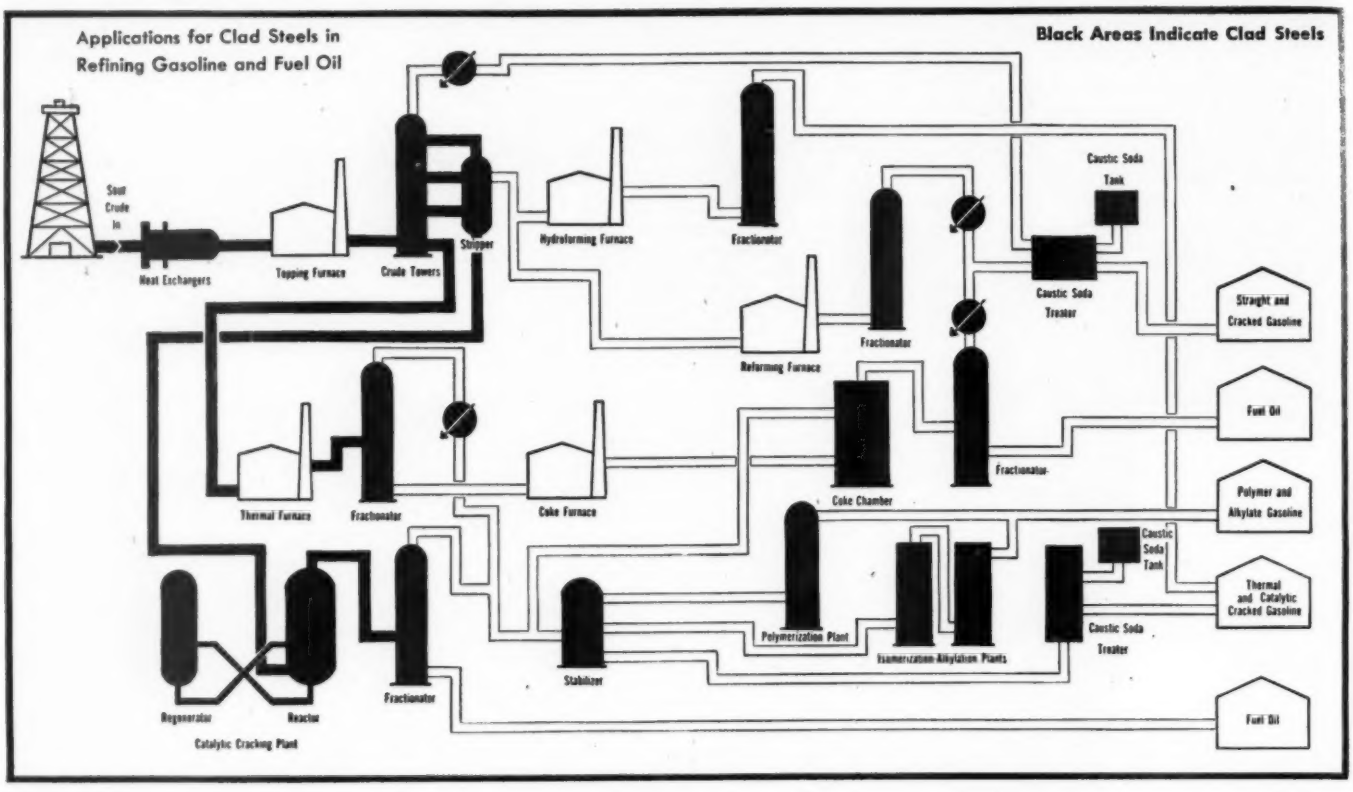

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Shale and Air Counter-Flow In New Continuous Retort

By HOMER REED and CLYDE BERG
Union Oil Co. of California

Principal Portion of Paper Entitled "Development of Union Oil Retorting Method for the Recovery of Shale Oil", presented at the Petroleum Mechanical Engineering Conference, Amarillo, Texas, Oct. 3-6, of the American Society of Mechanical Engineers.

In its shale oil research program Union Oil Co. of California has developed a new type of continuous retort which, because of a unique method of counter-flow of shale and air, eliminates the need for large quantities of cooling water and heat exchangers, thus reducing capital and operating costs. A 50-ton/day semi-commercial unit is now being operated and it is expected commercial units will reach a capacity of 4000 tons/day of shale. Oil recoveries exceed assay values, and large quantities of fuel gas produced in the retorting operation are a potential resource of power at the retorting and mining site.

THE DEVELOPMENT of the Union Oil Co. retort was carried out in conjunction with economic studies of a variety of existing shale retorting methods. Generally speaking, the existing methods of shale retorting resulted in operating costs which eliminated the possibility of their being employed when viewed from the standpoint of producing oil competitive with existing crude oil prices.

The factor which caused most prior shale retorting methods to fail from this economic aspect was that of capital investment. Large quantities of shale must be processed in commercial production of shale oil, and the quantities of heat which must be exchanged are consequently large. Facilities to effect transfer of the quantities of heat involved through exchanger surfaces or by means of re-circulating gas streams involve large investments. These investments were found to range as high as $1500 to $3000 per bbl.

Associated with this high investment aspect, most shale retorting processes incur a large utility requirement, necessitating tremendous quantities of cooling water, and frequently utilize all of the gas production from retorting to supply fuel for operation. The Union Oil retorting process, because of its simplicity, will be relatively low in capital cost and, furthermore, the utility requirements are virtually eliminated, no cooling water or supplementary fuel being required in the retorting operation.

This unit employs an underfeed principle with countercurrent flow of shale and air. The ash and clinkers are removed overhead and the oil drains out the bottom of the unit. The oil is distilled by downward flow of heat furnished by the combustion of the residual carbon on the shale clinker at the top of the kiln. The heat available for other purposes from the combustion of the stack gases is equivalent to 40 to 50% of the fuel value of the shale oil. Very efficient heat exchange is obtained in the unit by direct contact. The incoming air is preheated by the spent clinker and the products of distillation are condensed on the cool, in-

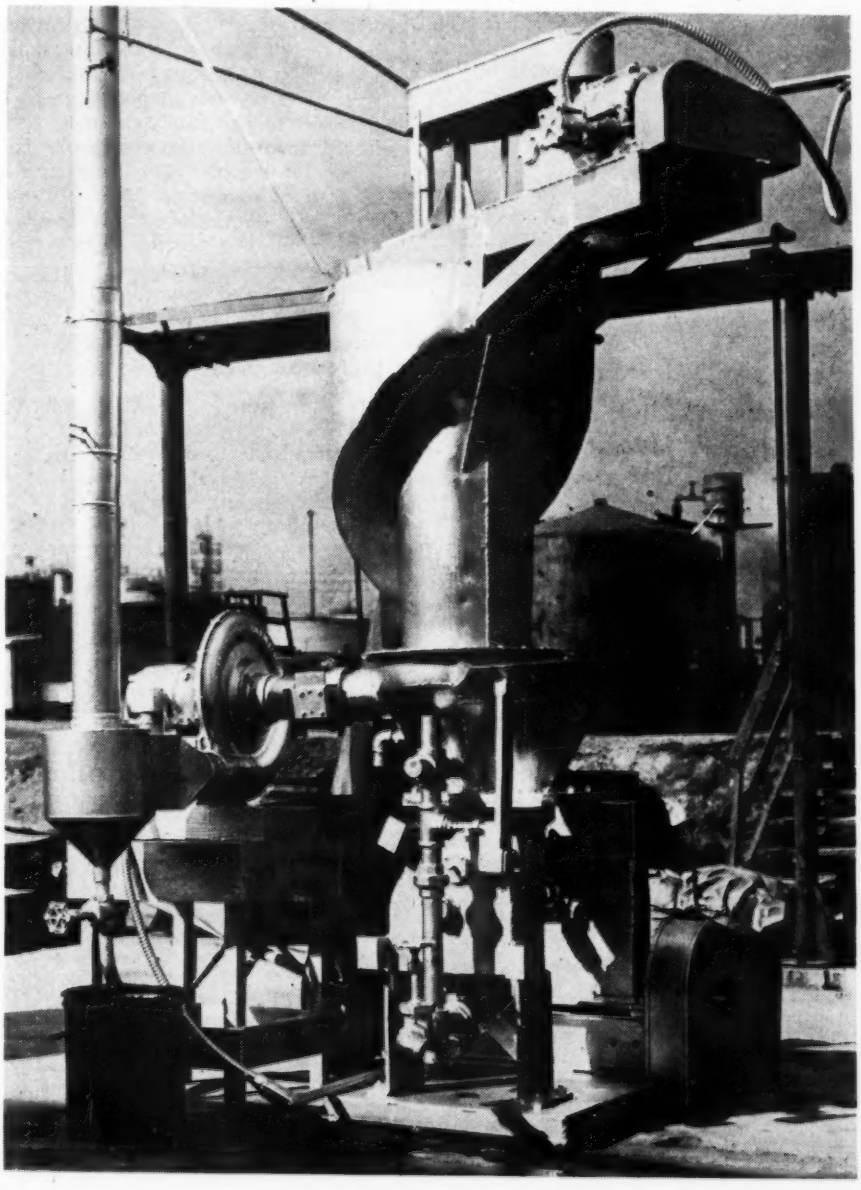

Fig. 1—Two-ton per day pilot plant oil shale retort

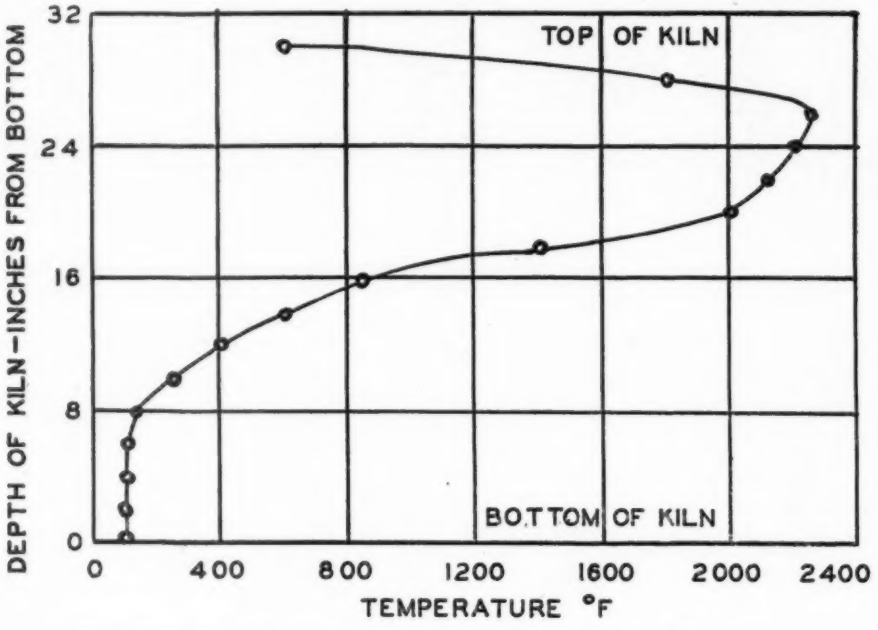

Fig. 2—Typical temperature profile for pilot plant shale retort

coming shale. The shale clinker is discharged hot because of the excess of heat available from combustion of residual carbon on the clinker.

The 2-ton/day pilot plant, (Fig. 1) consists of a cylindrical kiln with an underfeed mechanism, permitting the movement of granular shale upward through the unit with an overflow at the top, where the clinker is removed by a scraping mechanism and falls into an ash disposal chute. The sections of the kiln expand gradually upward, minimizing restriction to upward movement. The retorting section in this unit is 30 in. high and 12 in. in diameter at the bottom. A conical slotted section below the retorting section effects the separation of the oil and gas from the incoming shale. A collector surrounds this section, and the gas is drawn from this through a blower and oil collector.

The feeding mechanism is so constructed that any fines that fall through the grate return to the feeding piston and are re-introduced so that the gas and oil collecting housing cannot suffer from plugging due to accumulation of fines. The feeding mechanism is filled with oil to a level which provides a liquid seal which prevents the blower from pulling in air through the feed hopper. Between the kiln and the blower is a butterfly valve which controls the air drawn through the kiln. Discharge of the blower passes directly to the oil collection cyclone, where the liquid product is taken and the fuel gas is produced overhead.

The process occurring in the kiln retorting section may be divided into three zones. In the top zone heat exchange between incoming air and hot clinker leaving the unit is effected. In the lower portion of this top zone, combustion of the carbon residue on the clinker is effected, producing flue gas with a temperature near 2000° F. This flue gas progresses into the second zone, which may be termed the retorting zone, wherein the oil vapors are educted from the shale. The mixture of shale oil vapors and the flue gas progresses downward into the third zone, termed the condensation zone, where the incoming green shale is heated and the products of eduction are cooled and the oil condensed. The exit oil and gas from the kiln approach within 20° of the shale being charged. A graph of the typical temperature profile in the shale kiln is presented in Fig. 2.

Operation of Retort

To put the kiln in operation it is filled with shale. The crankcase and gas around the disengaging section are filled with oil from the previous run. A layer of kindling wood is placed on the top of the shale and ignited. The blower of the kiln is then started which draws the fire down through the shale bed, igniting the mass of shale. When it is observed that the top layer of shale has burned to a clinker, the feeding mechanism and the ash removal-equipment are started. Oil production is normally obtained from the unit within 10 to 15 minutes after ignition.

Results of pilot plant operations are presented in Tables 1 and 2. In a typical operation charging the

TABLE 1—Typical Pilot Shale Kiln Operation
(Operation on 55 gal./ton shale)

Shale	
Rate, tons/day	1.84
Oil Content by Retort, gal./ton	57.2
Oil	
Production, Bbl./day	2.50
Bbl./ton shale	1.36
Recovery, % oil by Retort	102
Gas	
Production, MCF/day	26.0
MCF/ton shale	19.1
Heat Content, Btu/cu. ft.	188

TABLE 2—Survey of Shale Oil
(Operation on 55 gal./ton shale)

Shale Oil

Gravity API at 60° F.	21.6
Water by Distillation	0.2
Vis. Say. Univ. at 100° F. Sec.	113
Sulfur, %	1.26

Refining Crude Distillation

Material	API 60° F.	% Dry Bases
Gasoline—410° F. e.p.	44.1	11.2
Gas Oil—41 Vis. Say. Univ. at 100° F.	29.2	27.9
Residuum	15.1	60.3
Loss		0.6
Total		100.0

Gasoline

Gravity API at 60° F.	44.1
Sulfur, %	1.15

Init.	10%	20%	30%	40%	50%	60%	70%	80%	90%	95%	Max.	Rec.	ABP
220	301	318	330	340	350	360	370	380	392	401	412	985	341.4

Gas Oil

Gravity, API @ 60° F.	29.2
Vis. Say. Univ. at 100° F. Sec.	40.6
Upper Pour Point ° F.	5.0
Sulfur, %	1.14

Init.	10%	20%	30%	40%	50%	60%	70%	80%	90%	95%	Max.	Rec.	ABP
435	502	510	526	540	554	570	587	608	630	647	676	980	558.0

Residuum

Gravity, API @ 60° F.	15.1
Vis. Say. Furol at 122° F. Sec.	95
Flash, COC ° F.	445
Sulfur, %	1.07

TABLE 3—Analysis of Gas from Shale Kiln
(Operation on 55 gal./ton shale)

	Mol %
Hydrogen	3.9
Nitrogen	57.5
Air	6.0
Carbon monoxide	11.0
Carbon dioxide	13.3
Hydrogen sulfide	0.4
Methane	3.3
Ethane	1.7
Propane	1.6
Butanes	1.0
Pentanes	0.3
Total	100.0
Specific Gravity	1.000
Gross Heating Value, Btu/CF	188

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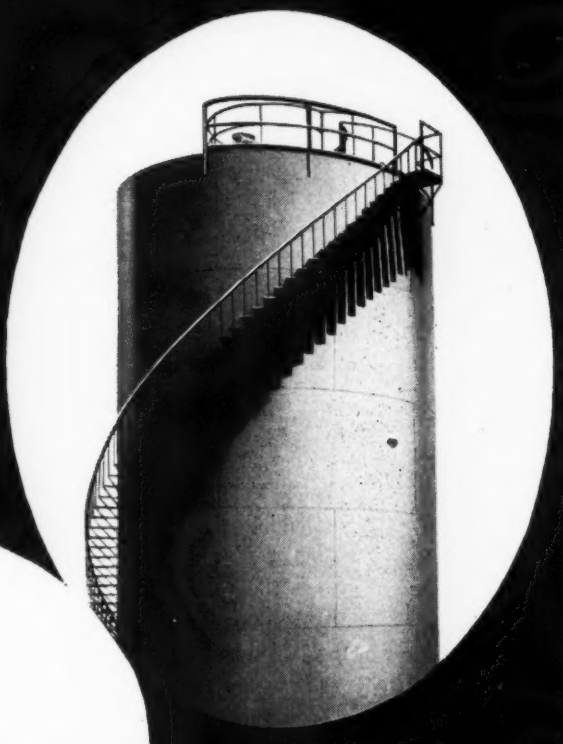

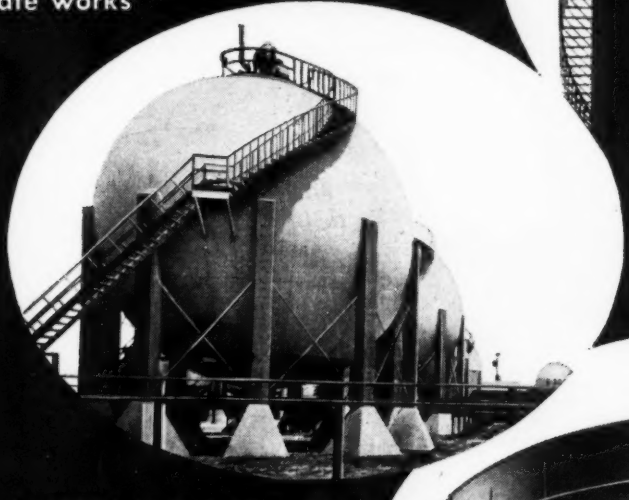

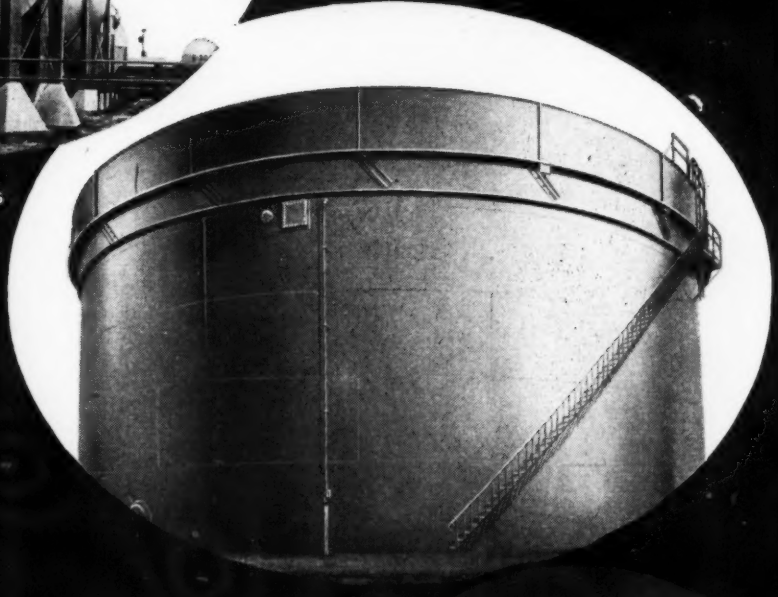

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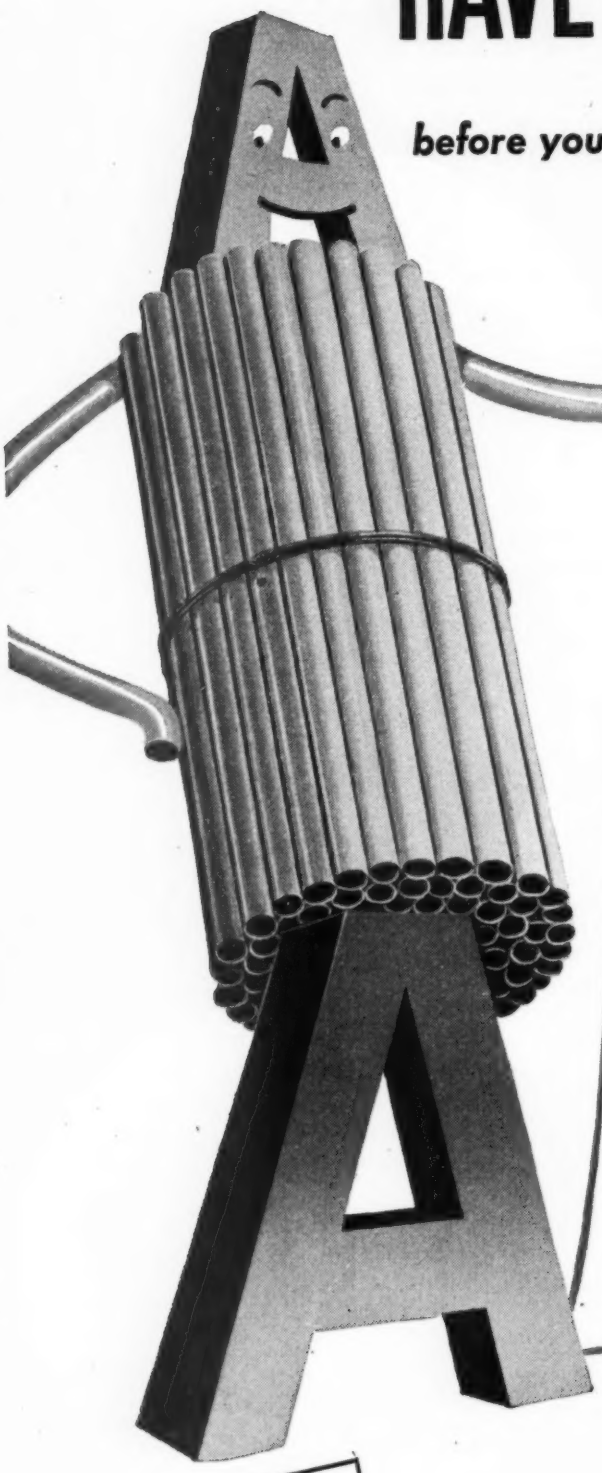

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unit at a rate of 1.84 tons per day, 58.0 gals. shale oil per ton of shale were produced, exceeding somewhat the retort analysis figure of 57.2 gals. per ton. In this operation, 19,100 cu. ft. of 188 Btu. content gas and 0.58 tons of ash were produced per ton of shale. The shale oil produced by the unit had a gravity of 21.6° API and a sulfur content of 1.26%. The analysis of the gas produced is given in Table 3.

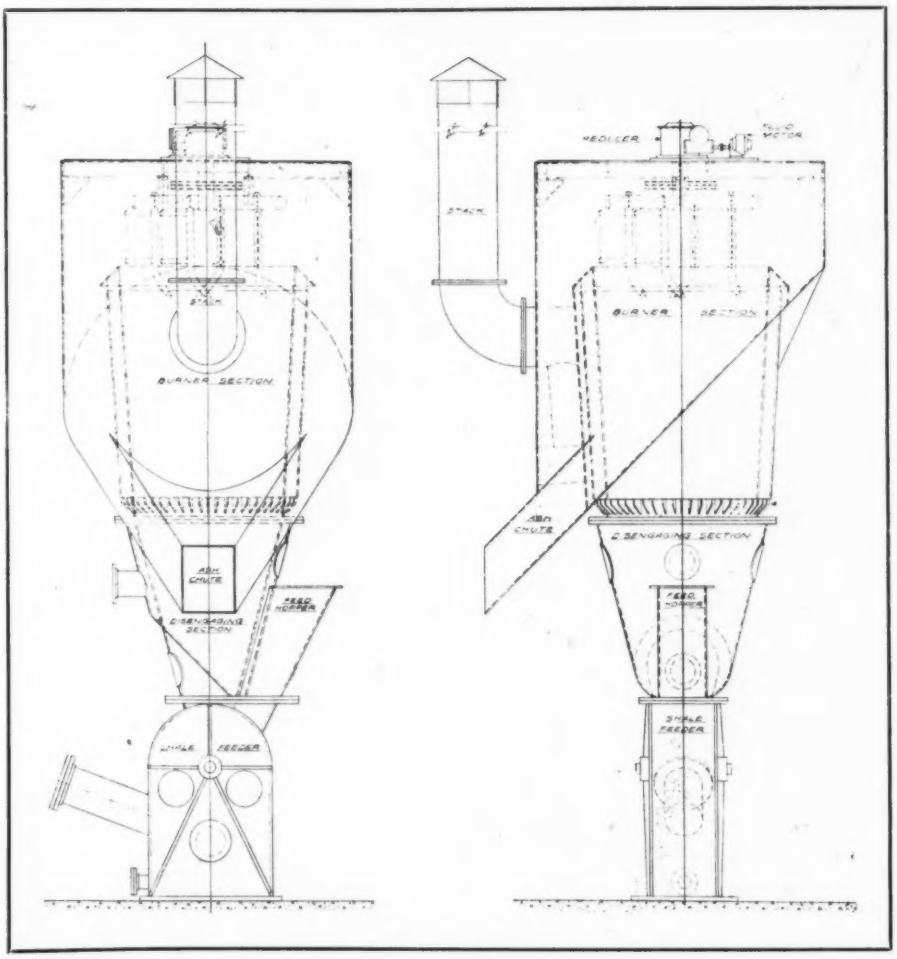
An appreciable quantity of nitrogen bases is present in this product. The sulfur distribution is somewhat unusual in that the highest content of sulfur is found in the lighter fractions of the stock.

50-Ton Day Unit

The 50-ton per day semi-commercial shale kiln is pictured in Fig. 3 and the assembly detail drawings presented in Fig. 4. The over-all design of this large unit closely parallels that of the small unit. However, the feeding mechanism is hydraulically actuated, which provides a maximum of flexibility and control of feeding action and an economical construction for large-size units. The ash removal mechanism is also driven by hydraulic mechanism.

The large shale kiln employs a finned retorting section with cowling to direct an air flow over the fins. A secondary stack draws the air through this cowling section. Cooling of the shell is designed to effect a maximum metal temperature of 750° F. at the burning zone. The gas flow through the kiln proper is provided by means of a Type W Roto-Clone. An Ultrasonic mist agglomeration unit processes the gas leaving the Roto-Clone to recover mist which carries through the preceding oil collecting unit.

The retorting section of this kiln is 7 ft. high and 4 ft. in diameter at the lower end and expands to 5 ft. in diameter at the top. The disengaging grate in the unit is similar to that of the smaller plant and has



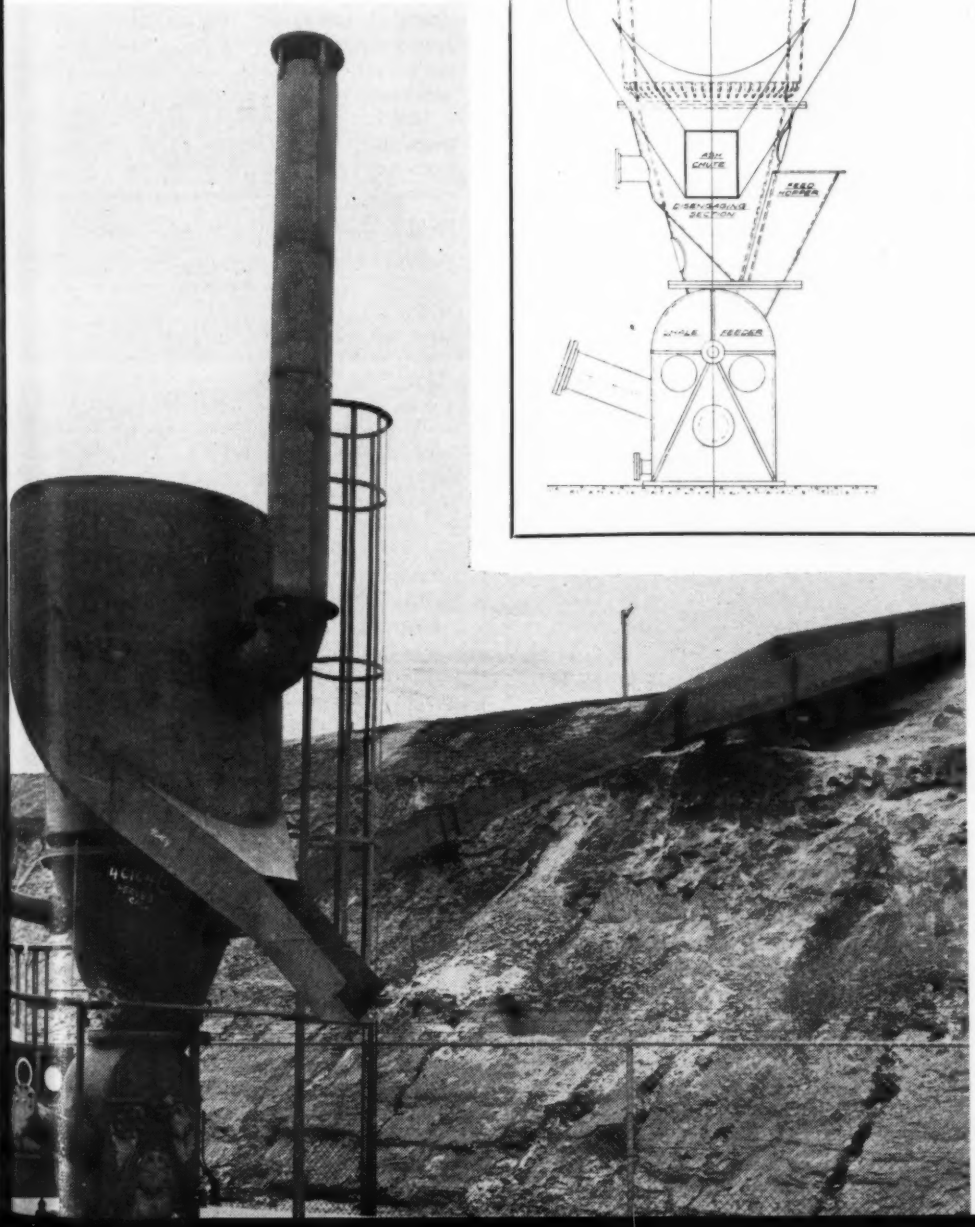


Fig. 3 (left)—Fifty-ton per day semi-commercial shale retort designed and built by Union Oil Co. The retort operates on a continuous basis

Fig. 4 (above)—Side and front elevation views of Union's 50-ton per day shale retort

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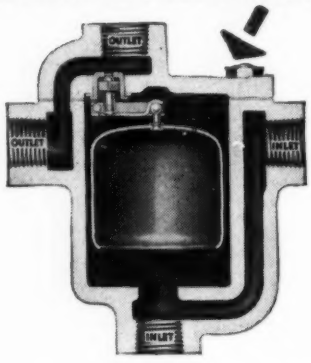

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automatic fines removal from the collector section. Operation of the kiln is entirely automatic. Flow of air through the unit is controlled by an automatic flow controller actuated by an orifice located at the outlet of the Roto-Clone. A temperature controller, actuated by thermocouples located in the shell of the retort, maintains the burning section approximately 2 ft. below the top of the kiln by control of the oil flow to the feeding mechanism.

Shale Retorting Characteristics

Retorting characteristics of shales of different grades of oil content from the Green River (northwestern Colorado) formation vary widely. Thirty-gal. shale as produced in the Bureau of Mines demonstration quarry operations exhibits very little fusion in being processed in the Union retort, and the particles of shale discharged from the kiln retain the same general physical dimensions as the original shale particles entering the unit. On the other hand, shale on the order of 50-55 gals. per ton is characterized by a semi-plastic condition in the burning zone and the clinker discharged overhead consists of semi-fused agglomerates which have been rolled into lumps by the overhead ash discharging mechanism.

Unlike the conventional retort or gasifying kiln, fusion of the ash is not considered a problem in operation of the Union retort. In this retort the plastic ash zone is not subjected to the weight of the mass of solids, but is exposed to the free action of the scraping prongs of the ash removal mechanism. The forces for motion far exceed those of the conventional retort where gravity provides the motivating power for downward motion.

TABLE 4—Products Derived from Retorting 140,000 Tons of 30-Gal./Ton Oil Shale

		Gross Heat of Combustion MMM Btu
Shale Oil, bbls./day..	100,000	623
Ash, tons/day	80,700	...
Fuel Gas, MSCF/day Gross heating value —79 Btu/SCF	3,850,000	304

Based on the retorting characteristics of shale from the Bureau of Mines, Rifle, Col., demonstration mine, the products that would be derived from retorting 140,000 tons of 30-gal. ton oil shale have been estimated. These quantities are tabulated in Table 4.

The energy content of the fuel gas produced in retorting is very considerable, amounting to 48.9% of the total thermal energy available in the shale oil produced. This fuel will provide far more than the power necessary for mining operations and would provide opportunity for considerable outside power generation and industrial operations.

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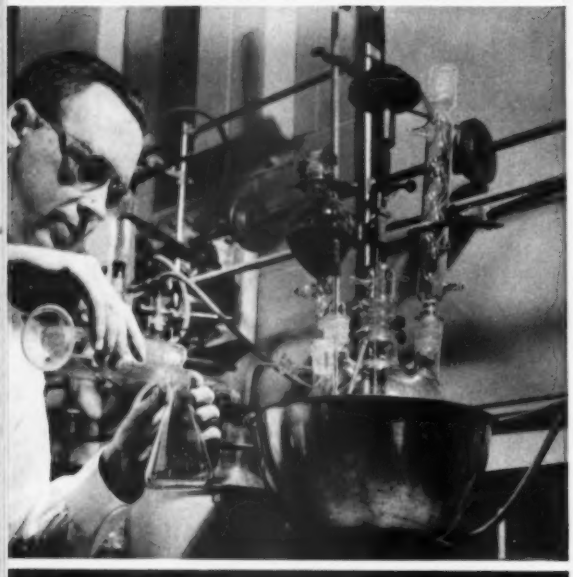
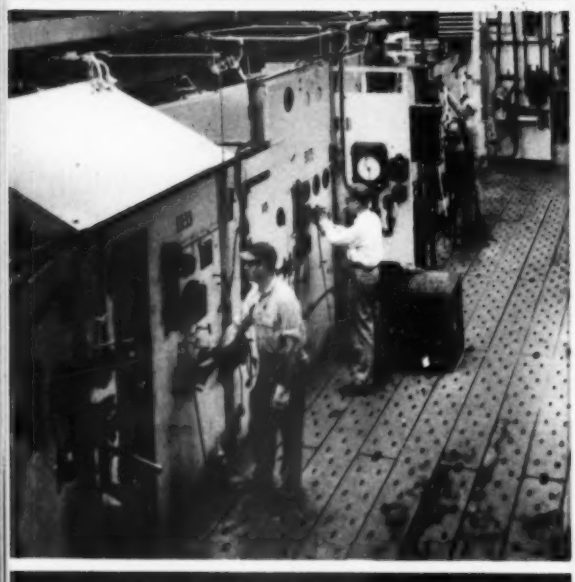


Laboratory apparatus for synthesizing new chemical compounds. These are used as additives to improve the quality of fuels and lubricants.



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SOAP AS A LUBRICANT *

By C. J. BONER, Chief Research Chemist
Battenfeld Grease & Oil Corp.

Experimental work and theory are presented to justify the conclusion that the soap in lubricating greases is a primary lubricant, rather than merely a thickener for the mineral oil. This is due to the bonding to the bearing metal of certain types of soap molecules which separate out of the grease to form a monomolecular film which clings to the bearing surface long after a hydrodynamic film has been squeezed out. The physical state of the soap and its dispersion in the mineral oil have an important effect on this lubricating characteristic. This theory of the mechanism of grease lubrication would call for changes in currently accepted specifications.

THE object of this paper is two-fold: first, to emphasize that soap is really a lubricant and not alone a carrier for oil; second, to indicate that all soaps of the same chemical composition are not equal in value as lubricants.

Dry Soap as a Lubricant

Illustrations of the use of soap alone as a lubricant are numerous. Metal and wood screws, especially the latter, are often forced into place against considerable shearing forces, hence a lubricant is advantageous. Calcium and zinc stearates have been used for such purposes with good results. Most carpenters, however use hand soap.

In expanding tubes when erecting boilers, soap pastes are used to reduce friction.

In drawing wire a pressure of 18,000 to 30,000 psi. is developed within the die, hence lubrication is required to reduce the resulting friction. Soap is almost universally used for this purpose, in many cases the wire passes through a bed of dry soap powder, picking up enough soap for lubrication as it passes through the die. In addition to sodium soap, aluminum palmitate, and aluminum, calcium and zinc stearates are used. Williams[15] claims that a film of electro-deposited heavy metal soap on a wire is an effective lubricant. This is effected by using the wire as a source of the metal and a sodium stearate bath as a source of the anion. It is stated that more than 11,000,000 lbs. of soap are used annually for wire drawing.

In molding plastics and rubber a lubricant is desirable. Barium, calcium, lead and zinc stearates have been found useful for the purpose. In fact any of the above and also magnesium stearate are employed to increase the "slip" of metal, wood, fiber, plastics, rubber, paper and leather. Granular materials are made more free flowing by a coating of metallic soap which acts as a lubricant.

Soap Solutions as Lubricants

When drawing some of the finer sizes of wire, aqueous solutions of sodium soap provide lubrication. Likewise, in drawing copper and brass, as in the manufacture of cartridge cases, such soap solutions are largely used, and the same lubricant was even employed in drawing some steel shell cases. How large this consumption is can be gauged by the fact that one small arms ammunition plant at one time used two carloads of soap chips per month.

In some of his early work on extreme pressure lubricants, Mougey[13] found that a solution of sodium oleate in water was more satisfactory than other lubricants tried.

For the lubrication of plastic-bonded fabric bearings Stuart[14] recommends a water solution of sodium oleate.

Previous Work

Hannegan[9] investigated the effect of metallic soaps upon the lubrication properties of mineral oil, particularly the effect on the coefficient of friction. Metallic soaps of cadmium, copper, lead, magnesium, nickel and zinc were prepared which had almost the theoretical content of metal (see Table 1) indicating that no free oleic acid was present. As is shown in the table, addition of these soaps to the base oil lowered the coefficient of friction in each instance, the value continuing to decrease for each increase in concentration of the soap. The friction tests were made on a Herschel Oilness machine which consists essentially of 3 steel balls sliding upon a flat plate.

Merchant[12] built a testing apparatus consisting of two cast iron blocks on the table of a milling machine, one sliding over the other and with a spring load. Since Bowden[4] and co-workers had shown that the means by which oleic acid reduced the friction between ferrous metals was through the formation of iron oleate on the surfaces, Merchant used this additive with this reaction in mind. Tests were first made with paraffin oil and then with the same oil with the addition of various proportions of oleic acid up to 1%. Not only was both the static and kinetic friction higher before the addition of the oleic acid, but also a condition of stick-slip occurred with oil only which was converted to smooth sliding when 0.2 mole per cent of oleic acid was present.

Merchant reasoned; "The fact that

TABLE 1—Effect of Metallic Soaps in Mineral Oil on Coefficient of Friction

Kind of Soap	Per Cent of Metal Actual	Per Cent of Metal Theoretical	Per Cent Soap	Coefficient of Friction
Non-base oil only	....	.....	0	.142
Cadmium oleate	16.64	16.655	0.1	.128
Cadmium oleate	....	.....	0.5	.123
Cadmium oleate	....	.....	1.0	.121
Copper oleate	10.06	10.154	0.1	.118
Copper oleate	....	.....	0.5	.113
Copper oleate	....	.....	1.0	.103
Lead oleate	26.92	26.919	0.024	.110
Magnesium oleate	4.14	4.144	0.1	.107
Magnesium oleate	....	.....	0.5	.098
Magnesium oleate	....	.....	1.0	.088
Nickel oleate	9.46	9.448	0.1	.114
Nickel oleate	....	.....	0.5	.088
Nickel oleate	....	.....	1.0	.082
Zinc oleate	10.40	10.412	0.01	.117
Zinc oleate	....	.....	0.05	.110
Zinc oleate	....	.....	0.078	.109
Oleic acid	....	.....	0.1	.112
Oleic acid	....	.....	0.5	.104
Oleic acid	....	.....	1.0	.095

Note: Base oil was a neutral, Saybolt viscosity @ 100° F—187.6.

* Presented Before National Lubricating Grease Institute, Chicago, Oct. 11-13, 1948.

the kinetic friction is also reduced by the presence of the oleate film suggests that the long aliphatic carbon chain of the latter is able to minimize the effects of surface roughness even under semi-hydrodynamic conditions. This appears to be characteristic of polar surface films."

After testing oil which contained oleic acid, the surfaces of the blocks were wiped free from all liquid, using a clean cloth. The blocks were then run in what appeared to be a dry state and the friction was unchanged, even after prolonged periods at high loads. The implication was that an adsorbed film of iron soap remained and provided effective lubrication. Following the above tests with apparently dry blocks, paraffin oil was added and tests continued with a resulting low friction value.

A recent report[3] bears out the fact that soap contributes to lubrication. It was found that in roller bearing lubrication grease allows a lower temperature rise over ambient than does oil. In the tests cited an oil of 150 sec. S. U. vis. at 100° F. showed a rise over ambient of 92° F., while a lubricating grease containing oil of 105 sec. S. U. vis. at 100° F. showed a rise of 25° F. and a grease with an oil of 300 sec. S. U. vis. at 100° F. showed a rise of 45° F.

Experimental Work

An Almen E.P. testing machine was used to determine not only the relative value of various soaps as lubricants, but also the comparison in lubricating value with other materials. Results are shown in Table 2. This is a familiar E.P. testing instrument where split bearings exert pressure on a ¼-in. shaft rotating at 600 rpm. A load of 1000 psi. is applied every ten seconds until scoring of the metal occurs or until a full load is applied. Normally, the load which a lubricant will carry for ten seconds without seizure is reported as the film strength. In most of our tests, we added the load at the above rate but when a load of either 5000 or 6000 lbs. was reached, the run was continued until seizure occurred.

With the exception of two soaps obtained by extraction of lubricating greases, the soaps tested were dry powders which of course did not lend themselves as readily to application as would liquid or even plastic products. In conducting a test, some of the soap was placed between the bearings and the shaft when the machine was assembled. Following complete assembly, soap enough to cover the shaft was added.

To determine if other solids would perform as well as soap, tests were made with a graphite of 200 mesh containing 99% graphitic carbon and with a mica of 100 mesh. Both these gave immediate failure with a load of 1000 psi.

The same was true of a silicon fluid with a 1000 psi. load and of an SAE 20 solvent neutral oil with a 5000 psi. load.

All of the soaps tested were either neutral or basic, hence the lubricating value cannot be attributed to any free fatty acids present. They were commercial products, no doubt, prepared by metastasis. From Table 2 you can see that all of the soaps tested had some lubricating value and in most cases kept the metal free from scoring for several minutes. In contrast the mineral oils tested gave immediate seizure at loads of 4000 or 5000 psi.

In order to determine if the soap in some of our lubricating greases was the primary lubricant, two greases were selected; namely a No. 2 NLGI grade of calcium base grease containing an oil of 300 sec. S.U. vis. at 100° F and a complex barium soap grease, containing an oil of 500 sec. S.U. vis. at 100° F. The oils used in compounding these greases were tested as were the finished greases. Then, repeated extraction of each grease with acetone was carried out to remove the mineral oil, free fat and fatty acids. The resulting soaps were tested and, since no seizure occurred in 30 minutes with a load of 5000 psi., the load was increased to 10,000 psi using new shafts and bearings. Still no failure occurred. This in contrast with immediate seizure at a load of 4000 psi. with either oil and a seizure in a few minutes with either grease at a load of 5000 psi.

Since the fats used in the two test lubricating greases had titers of about 42, the recovered soaps were gummy products rather than dry powders. This physical state no doubt gave a better distribution of the lubricant than in the case of the dry soaps.

From the above experiments, it seems reasonable to conclude that the soap in these particular lubricating greases is a primary lubricant, rather than merely a carrier for the mineral oil. Further, any soap tested provided a better protection against seizure than did any mineral oil tested.

Nature of Soap Film Contributing to Lubrication

Langmuir[10], working with monomolecular films of metallic soaps, found that the carboxyl groups of the soap attached themselves to the polar metal and the long chains projected at an angle. If two metal surfaces, which are adjacent, are coated with such oriented films, it is found that effective lubrication is obtained. What is visualized is that we have a structure much like bristles on a brush, with the ends free to glide over one another. Germer and Starks [6] found that mild rubbing would remove all but one molecular layer of barium stearate from a chromium surface and that further rubbing did not remove this layer. This soap molecule, perpendicular to the surface, was shown in an X-ray projection of the above surface.

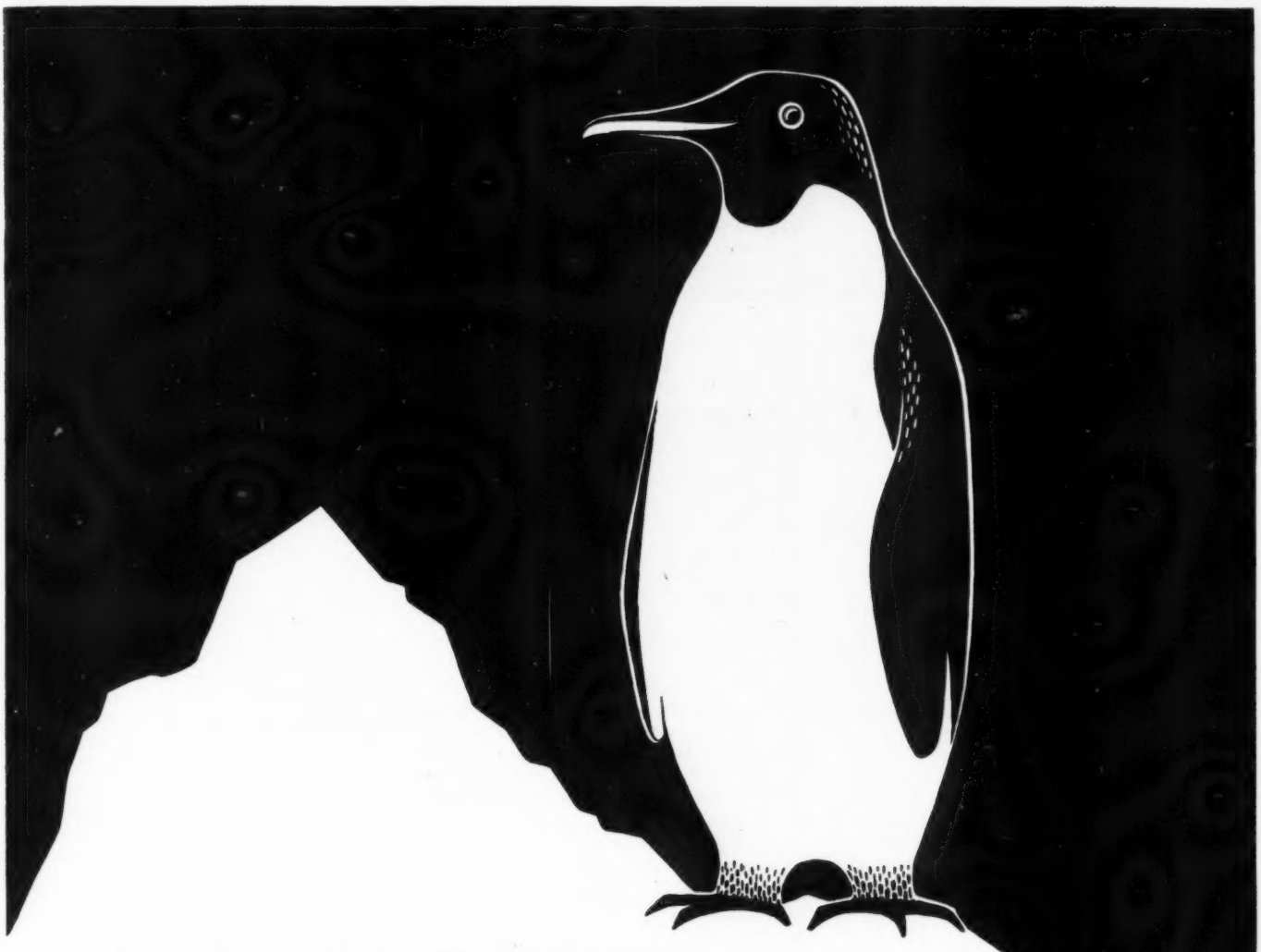
The surface which can be covered by such a film is large in comparison with the amount of soap involved. It is stated that metal stearates are now made which give a coverage of 22,000 to 25,000 sq. cm. per gram of soap[1].

Hannegan[9] stated "from the shape of the curves obtained by plotting the coeffecient of friction against the concentration of soap, one would be inclined to believe that adsorption of the soap on the lubricated surfaces was taking place as the curves are similar in form to the adsorbed isotherm."

Gallay and Puddington[7] were able to demonstrate the orientation of soap toward a polar surface by heating calcium stearate to 150° C.

TABLE 2—Results of Tests on Almen E.P. Testing Machine

Lubricant	ASTM Acidity or Alkalinity	Loads Lbs. psi	Torque	Period after Loading before Failure
Dry shaft	.....	1000		10 sec.
99% pure graphite, 200 mesh	.....	1000		immediate
Ground mica 100 mesh	.....	1000		immediate
Silicon liquid, 500 cstks @ 25° C	.....	1000		immediate
SAE 20 High VI oil	.....	5000		immediate
SAE 30 Smackover oil	.....	5000	16	6 min. 15 sec.
Barium Stearate A	neutral	6000	6	12 min.
Barium Stearate B	neutral	5000	5	6 min. 20 sec.
Calcium Stearate	0.01% alkaline	5000	5	8 min.
Lead Stearate	neutral	5000	5	3 min. 50 sec.
Lead Stearate basic	.....	5000	5	37 sec.
Lithium Stearate	neutral	5000	6	1 min. 40 sec.
Lithium Stearate	0.01% alkaline	5000	7	12 min.
Sodium Stearate	neutral	5000	5	9 min.
Strontium Stearate	neutral	5000	6	35 min. no failure
Ca Cup 300 oil #2 NLGI	alkaline	5000	11	4 min. 15 sec.
Oil from above cup	.....	4000		immediate
Soap from above cup	alkaline	5000	2	30 min. no failure
Soap from above cup	alkaline	10000		no failure
Complex Barium Grease	alkaline	5000		25 sec.
Oil from above grease	.....	4000		immediate
Soap from above grease	alkaline	5000	2	30 min. no failure
Soap from above grease	alkaline	10000		no failure



Carrier centrifugals give plus performance at —150 F

For processes requiring temperatures down to —150 F or lower, many refineries and chemical plants use Carrier centrifugals in the refrigerating cycle.

They find the design of these high-efficiency units successfully overcomes the problems of compressing petroleum and halogenated hydrocarbons at extremely low temperatures. Because the bearings are located outside the gas passages, difficulties with lubrication are virtually eliminated. This same design feature improves efficiency by preventing oil fouling of heat-exchanger surfaces. Carrier centrifugals are used with interstage flash cooling and straight series staging to reduce exchanger surface and boost efficiency, as well as in cascade cycles.

These compact, dependable compressors provide exceptional performance and economy in many refinery and chemical-plant processes. The first cost is low and they can be easily and quickly installed. They require no expensive foundations and can be operated without housing. Rotative design assures low operating and upkeep cost.

The Carrier Centrifugal Compressor is designed and built with the same engineering skill that developed rotative refrigeration more than 25 years ago. This unrivaled background and experience make Carrier your best investment. Carrier Corporation, Syracuse, New York.

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in either glass or platinum and then allowing the mass to cool. By this means, they were able to obtain polar surfaces on the portion of the soap adjacent to the container while an interior surface, planed off smooth, was non-polar. The same treatment in a vessel of fused quartz did not show this orientation. These workers state that "the formation of a surface of a polar nature against glass or platinum must involve the exposure of calcium carboxylic groupings on that surface."

In order to prevent metal-to-metal contact of surfaces to be lubricated, the lubricating film must be so firmly bound to the metal that it will resist pressure and shearing forces which tend to rupture the film. Since most mineral oils do not have polar characteristics, they do not attach themselves to the metal in the same way as soaps. In the case of the soaps the polar end is attached firmly to the metal surface and the long chains of the non-polar end project into the oil layer. It is readily seen that since this gives an orderly arrangement, less work will be required to move one film over the other than if the arrangement were random. The advantage of soap over other polar agents was shown by Germer and Starks[6] who found that hydrocarbon chains of barium stearate on metal were more precisely oriented than those of stearic acid.

How firmly soaps adhere to metal is shown by an observation of Hannegan[9] who found that, if oil containing free oleic acid was permitted to stand on polished steel plates, the surface darkened, presumedly due to the formation of iron soap, and that the darkened area could only be removed by abrasives. Others have found the same conditions as shown in statement in Lubrication[2] "When one end of the lubricant molecule is highly reactive, it has the property of forming a powerful bond with a steel surface. Then it is called a polar molecule. It is 'adsorbed' to the surface so powerfully that the last traces can only be removed by grinding. A straight mineral oil has no such effect."

All this then comes back to the adsorption hypothesis of lubrication in which it is suggested that the bearing metals have a stronger attraction for certain types of molecules than for others and that molecules of these types will separate out of the oil to form a tenacious, concentrated film which will cling to the surface long after a hydrodynamic film has been squeezed out.

Physical State of the Soap

Conceding that it has been shown that soaps have advantages as lubricants, it seems quite evident that the soap will have a better chance to act as a lubricant if it is in the proper physical state. Many of the metallic soaps are solids with melting points ranging up to 500° F. If such soaps were used as is, no doubt the excess soap which could not become attached to the metal surface would pile up and be an obstruction to movement of the machine parts. Therefore, if such soaps can be used in a plastic or semi-fluid mixture, they should be more satisfactory. This, then, points to a product of the nature of a lubricating grease.

Our conception is that the mineral oil portion of a lubricating grease is simply a carrier for a dispersion of the soap which is the primary lubricant. We must have true dispersion and not simply a mechanical mixture. In the latter case, we might have not only the piling up of solids mentioned before, but also large aggregates of the soap molecules which would not have the chance to orient themselves as will smaller micelles or even molecules.

This brings us to a weakness of not only the generally prevalent conception of what a lubricating grease should be but also the deficiency of present specifications. Some feel that if specifications are set up with a certain percentage of a definite metal soap, etc., they will obtain a uniform product. Perhaps such ideas originated because a lubricating grease supplied by A, which fell in the soap content specified, performed satisfactorily. However, suppliers B and C complied with the specifications, yet their products failed badly in service. Until due recognition is given to the fact that processing and consequent physical state of the soap is more important than other specifications in many lubricating greases, the user will not always obtain the most satisfactory service from such products.

Since many are in general conversant with the manufacture of lubricating greases, the factors which may influence the physical state of the soaps will not be discussed. However, it is of interest that five or more phases are possible with water and any pure sodium or potassium soap. That point is illustrated with jars of potassium oleate in water. The solid phase, representing "middle soap", contains only 25% of potassium oleate, while the liquid product, representing "neat soap", contains 65% of potassium oleate.

McBain and Mysels[11] stressed the variation in the physical state of aluminum dilaruate even when the chemical composition was the same. In one physical state this soap was completely soluble in certain hydrocarbons while in another physical state it was almost insoluble. The same situation was encountered with aluminum soaps used for gelling gasoline during the late war. The soap produced by one supplier formed a gel readily in a certain gasoline while that suplied by two other suppliers would only form such a gel with difficulty. Analysis indicated that the three soaps were the same chemically.

Calcium stearate was heated in mineral oil by Galley and Puddington[8] who found that "on cooling the highly dispersed sol, depending upon the unsaturation of the soap, the nature of the oil, or the presence of various solvent factors, gave a wide range of physical properties with the same soap concentration, e.g., (a) a smooth lubricating grease of short texture, (b) a thickened oil of low consistency, (c) a thickened oil of grainy texture, (d) pieces of coagel of free oil, changing on standing to a complete separation of hardened soap and free oil."

As a further illustration of this point, a mixture of aluminum stearate and mineral oil was heated to 300° F. A portion of this was poured on a metal table top in a thickness not exceeding ⅛ in. This represents rapid chilling. Another portion was placed in a beaker which was wrapped with cloth so that the insulation provided slow cooling. Samples of these two products, of the same chemical composition, clearly indicate there is some difference in the physical state of the soap. One product would be acceptable to the trade, the other could not be marketed.

Conclusion

Both theory and experimental evidence point to the fact that soap has lubricating value and consequently this component of lubricating greases is a lubricant and not alone a thickener.

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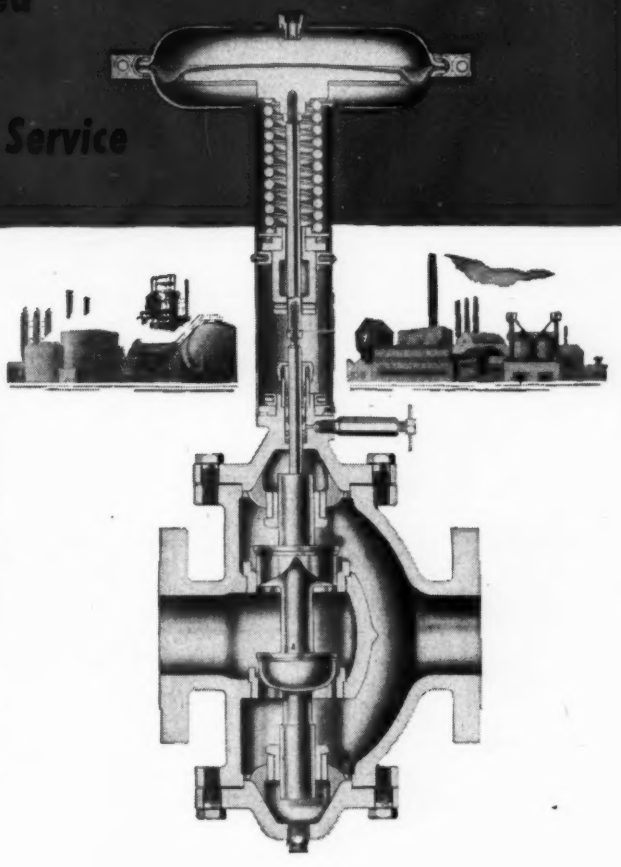

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Main entrance to the administration building of Sinclair Refining Co.'s new multi-million dollar Research and Development Laboratories, recently dedicated at Harvey, Ill.

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Heart of the company's $150 million overall expansion program, the nine buildings comprising this modern research plant will be the home of countless projects designed to explore all phases of petroleum technology, from the production of oil from shale and coal to the improvement of lubricants, fuels, and the many other products in daily use that are derived from petroleum hydrocarbons.

Employing more than 400 scientific and administrative personnel, the laboratories represent another great stride forward in a long-time growth of research activities begun by the company before World War I when Sinclair developed methods for thermal cracking.

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1. Exploratory and applied research for the development of new processes and products.
2. Fundamental research in the basic relationships pertaining to the chemical, physical, and engineering phases involved in the studies and projects under consideration.
3. Development on pilot plant scale of any operation or product in which commercial possibilities are indicated, for the purpose of obtaining further information regarding commercial evaluation and construction, and operating requirements.
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5. Availability of best analytical methods and facilities, both chemical and physical.
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7. Supplying complete process design information on all commercial operating units at Sinclair plants.
8. Maintenance of full knowledge

Laboratory Photos—Pp. 1200-1
Story Continued on Pg. 1202

CENTRAL CONTROL FOR ENGINE TESTS

Centralized controls and recorders feature engine tests on lube oils at Sinclair's new Laboratories in Harvey. Two pairs of panel boards are placed back-to-back down the center of this corridor-like control room. Flanking the room are four test cells, two on each side, housing Diesel, automobile, and aviation engines. Technicians observe operation of dynamometer test stands through windows, seen along left wall in this view. Equipment on panels includes individual controls for each of four engines in each test cell. The arrangement is said to permit one operator to run an entire series of tests simultaneously, moving around the control room from panel to panel to record data

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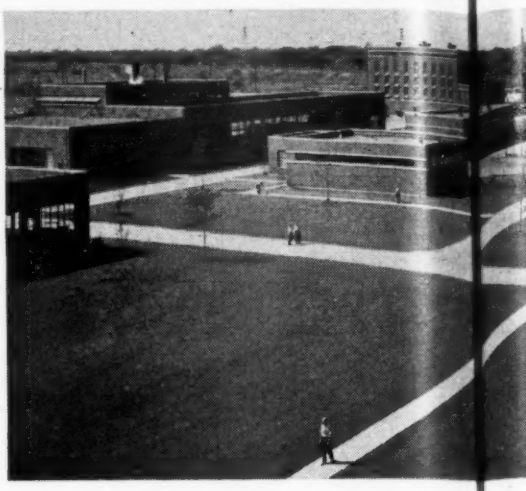
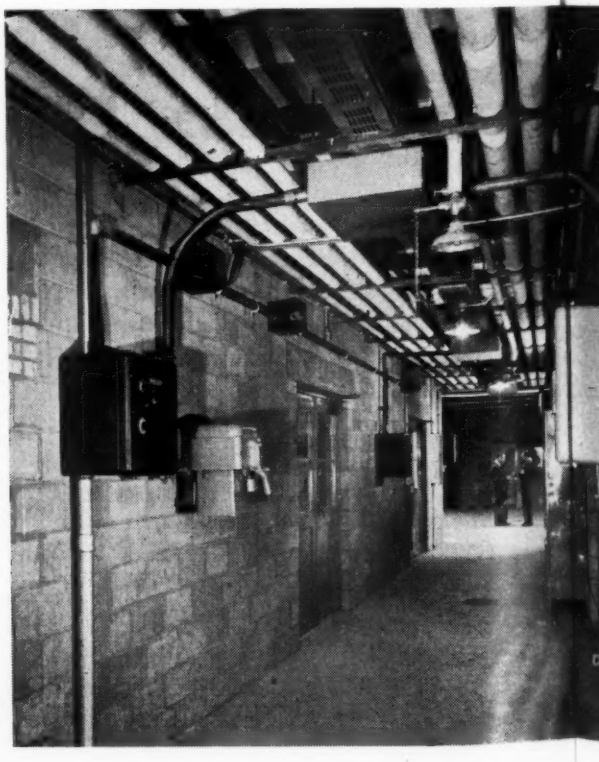
Two of General Motors new 12:1 compression ratio engines will be used by Sinclair in its new laboratory for testing fuel performance. This one, not yet installed, will be used for dynamometer test runs, while the other is installed in a 1949 Oldsmobile for road testing

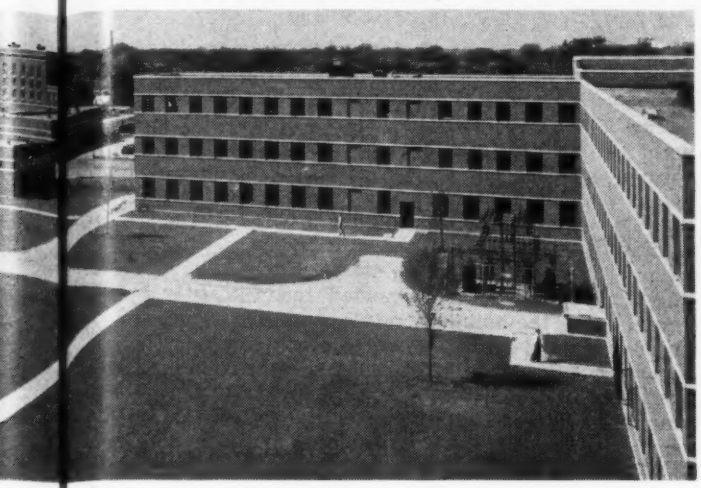


This view from the roof of the main laboratory o atories shows the campus-like arrangement of th

SINCLA RESEARCH DEVELOP LABORAT

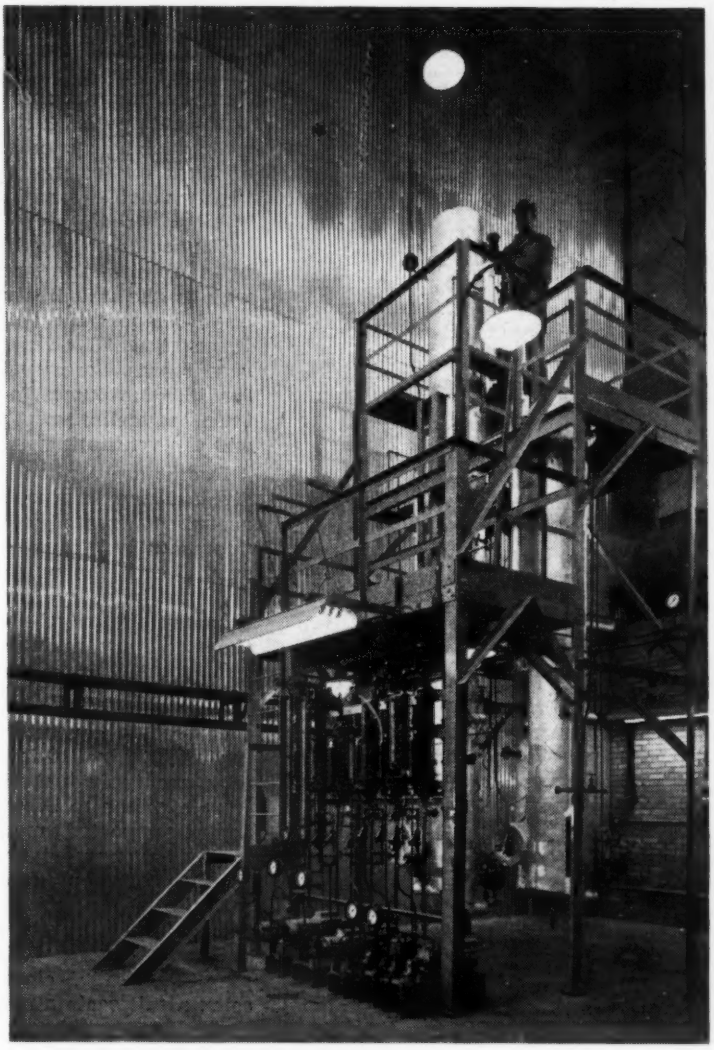
Typical of the individual laboratories is this one, used for catalyst preparation. Each laboratory is air conditioned, with air entering through thermostatically-controlled temperature units behind grills in the window sills



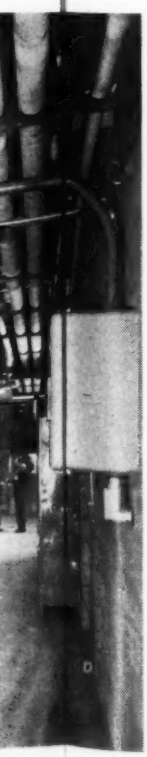


n laboratory at Sinclair's new Research and Development Labor-
ngement of the buildings, distributed over an area of 20 acres

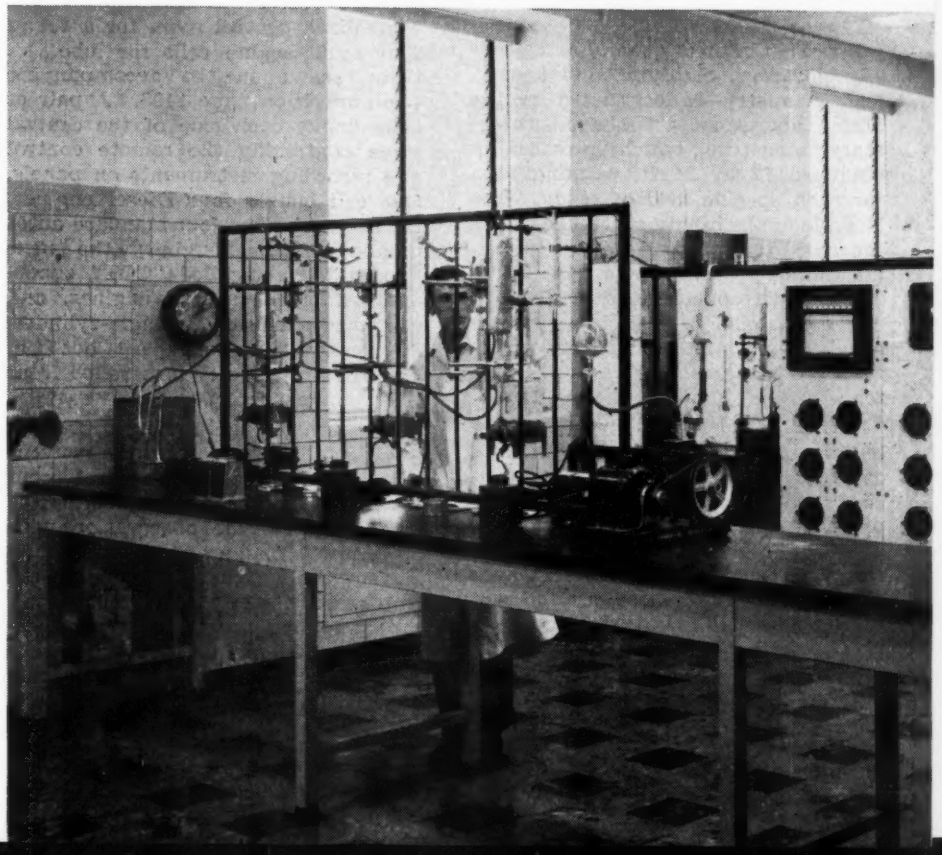
NCLAIR'S ARCH and ELOPMENT ORATORIES



Sinclair's pilot plant building is one 50-foot story high, partitioned into six sections. Sheets of corrugated aluminum form the walls separating the several pilot operations one from another, permitting individual room control and ventilation in the interest of maximum safety



Service distribution lines in this basement corridor are easily accessible, plainly identified. Note the safety showers installed at intervals along the ceiling just below the service lines



All service piping and power lines in the main laboratory are distributed in the walls around the perimeter of the building, and accessible through removable panels in the wainscoting. Besides eliminating the need for under-floor distribution systems, this method permits utmost flexibility in rearrangements of equipment to meet changing needs

of all refinery operations in the company and assistance for refinery managers in improving operations.

9. Appraisal of economic position of existing as well as of contemplated commercial operations for the guidance of management.

Located at the 147th St. station of the Illinois Central Railroad, the laboratories are about 22 miles from downtown Chicago and 12 miles from Sinclair's refinery at East Chicago. They were designed and built by the Austin Co., who developed the overall plan in collaboration with E. W. Isom, Sinclair's vice president in charge of research. The engineering division of the Sinclair research and development department, under the direction of H. C. Kuhn and A. H. Eron, supervised the details of planning and construction. Field construction was started in January, 1946.

The nine major buildings comprise an administration building, main laboratory, engine laboratory, lube treating and distillation laboratory, exploratory research laboratory, fuel application laboratory, pilot plant building, shops-storehouse-boilerhouse, and a first aid-clock-change house.

The general arrangement represents the modern trend toward the adoption of institutional campus lines in the layout of industrial research centers. With a total of 215,000 sq. ft. of floor space, the buildings have been grouped in one landscaped 20-acre block so that the individual units can be doubled or trebled in size without encroaching on each other or on undeveloped sections of the entire 38-acre property.

Main Laboratory

Research in three general categories —exploratory, catalytic, and analytical chemistry—is conducted in the Main Laboratory, a U-shaped, three-story structure which provides a standard 12 by 24 ft. working area for each specific field of study. Use is made of the highly specialized tools for research available today, including the mass spectrometer, the ultraviolet spectrophotometer, the infrared spectrometer, emission spectrograph, electron microscope, X-ray diffraction unit, and X-ray spectrometer.

Specific projects underway in the building include studies of cracking catalyst activity, synthesis of lubricant additives, development of rust preventives, improvements in lube oil and wax processing, catalyst preparation, and organic chemical research to develop useful by-products and synthetic materials from petroleum.

The building is designed for maximum functional efficiency. Removable steel panels at strategic points between the more than 60 laboratories permit complete flexibility in expanding individual units. All laboratories are fully air-conditioned. Sample storage rooms are all equipped with automatic carbon dioxide fire extinguishing systems, and a number of them are refrigerated for storing highly volatile samples at as low as 0° F.

Connected to the Main Laboratory by a single-story, enclosed passageway is the Administration Building, an L-shaped three-story structure. It contains 73 offices, three conference rooms, library with stack space for 12,000 volumes, a 200-seat cafeteria, miscellaneous record storage, and the ventilating machinery rooms.

Rooms are air-conditioned with individual temperature controls, have acoustical treated ceilings, and are fluorescently illuminated. Murals symbolizing the progress of the petroleum industry through research decorate the wood-paneled walls of the two-story main entrance hall.

Engine Laboratory

Housed in concrete test cells built into the 120 by 210 ft. Engine Laboratory are individual engines ranging from airplane to Diesel power plants. Spring-supported metal foundations for the engine-dynamometer test stands, set on footings through to the basement, isolate vibrations from the main floor. The building contains four multi-engine test cells, eight single-engine cells, a full scale aircraft engine cell, control rooms, chassis dynamometer room, five knock test cells, six experimental fuel test cells, and 15 other special rooms.

A feature of this laboratory is the centralized control room for a set of four multi-engine cells for lube oil tests, shown in the accompanying photograph on page 1198. A pair of cells flanks each side of the central room containing the remote control and recording instruments on panels. One cell houses four Diesel engines. the second houses four standard automobile gasoline engines, the next houses four so-called "COT" supercharged aviation type engines, and the fourth houses 24 single-cylinder, Lauson-type engines. All but the Lausons are remotely controlled from the main panel.

The control panel arrangement represents a departure from the conventional type of test cell-control room set-up where the instruments are placed around the observation windows in the manner of a console. At Harvey the design will enable an entire series of tests to be run simultaneously by one operator, if necessary, who will make the rounds checking his controls and recorders and observing the various test stands through the windows into each separate room. Each window comprises three panes of glass of varying thicknesses 1/4, 1/2, and 5/8 in., so as to avoid the resonance which would be set up if the panes were identical in thickness.

The elimination of vibration in the Engine Laboratory was worked out by Austin Co. engineers through the use of massive, independently supported inertia blocks. Each engine test bed is supported independently of the building on two concrete arches. Steel girders mounted on these arches give them stiffness and support the so-called isolaters reducing transmission of engine vibration to other test beds and the surrounding building.

On the large installations, eight of these isolaters are used. Riding on the isolaters is an inertia block of steel-reinforced concrete measuring 16 x 5 x 4 ft. Bolted to this concrete block is the cast iron engine test bed, six in. thick and weighing nearly one ton.

Pilot Plant

Particularly impressive are the building and equipment comprising the Pilot Plant. Measuring 82 by 121 ft., this structure is divided into 6 bays, each 54 ft. high, and separated by corrugated aluminum partitions. This was done to provide greater flexibility, as the metal walls can be removed if two cells are needed for operating a single, but larger pilot unit. Among units already installed and in operation are a four b/d fluid cracking pilot plant, a four b/d continuous vacuum still, a thermal cracker, and an experimental oil shale retort.

For catalyst activity research in the intermediate stage between test tube and pilot plant, the extensive bench-scale units, too large for other laboratory buildings, are mounted in the individual work areas in the Exploratory Research Laboratory. Units are provided here for study of chemical reactions in continuous flow reactors at up to 3000 psi. operating pressures. Bomb reactors for pressures up to 75,000 psi. as well as gas compressors and storage vessels are being installed.

The Lube Treating-Compounding-Distillation Building provides a floor area of 9200 sq. ft. with ceilings 21 ft. high, permitting installation of distillation and other large scale quipment such as acid treaters, propane treaters, agitators, and batch stills. Work here is concerned with new oil blends and additives, as well as the preparation of special oils and other new products obtainable by distillation and solvent treating.

Remaining buildings at the Harvey research and development center include a special laboratory for development of heating oils for domestic heating units, a personnel building, and a storehouse and boiler room.

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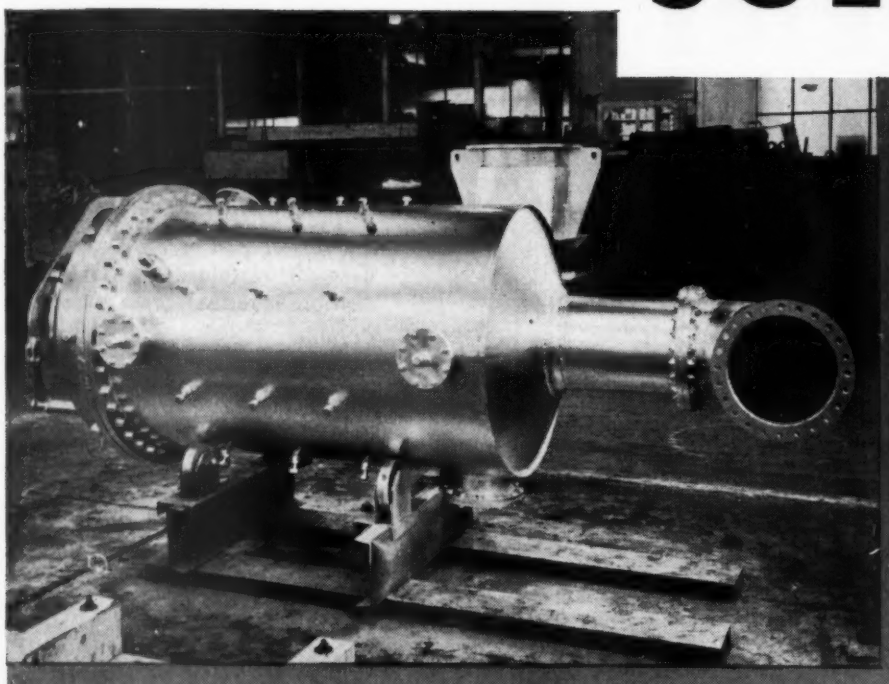
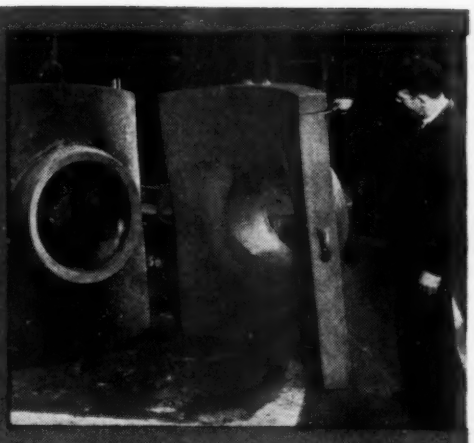


Direct Contact Air Heater designed to preheat air at 1500 to 1700F at 80 pounds pressure. Internal parts are made of 25% Chromium 20% Nickel.



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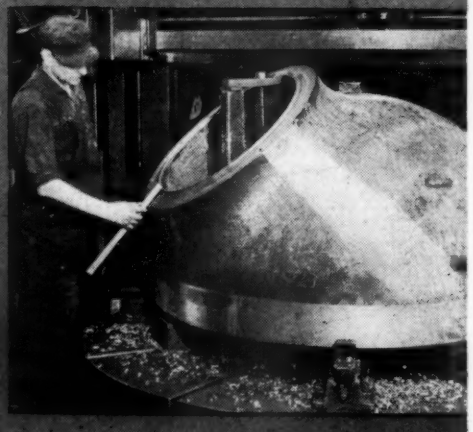

Clad Steel Conical Head for large fluid catalytic reactor. Welding in highly stressed areas eliminated by use of knuckles.

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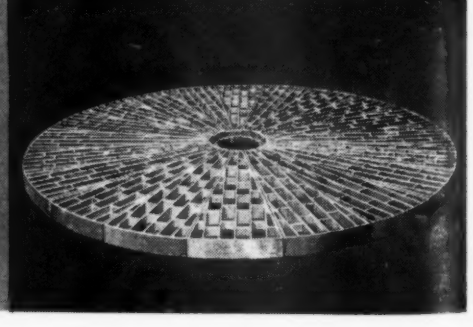
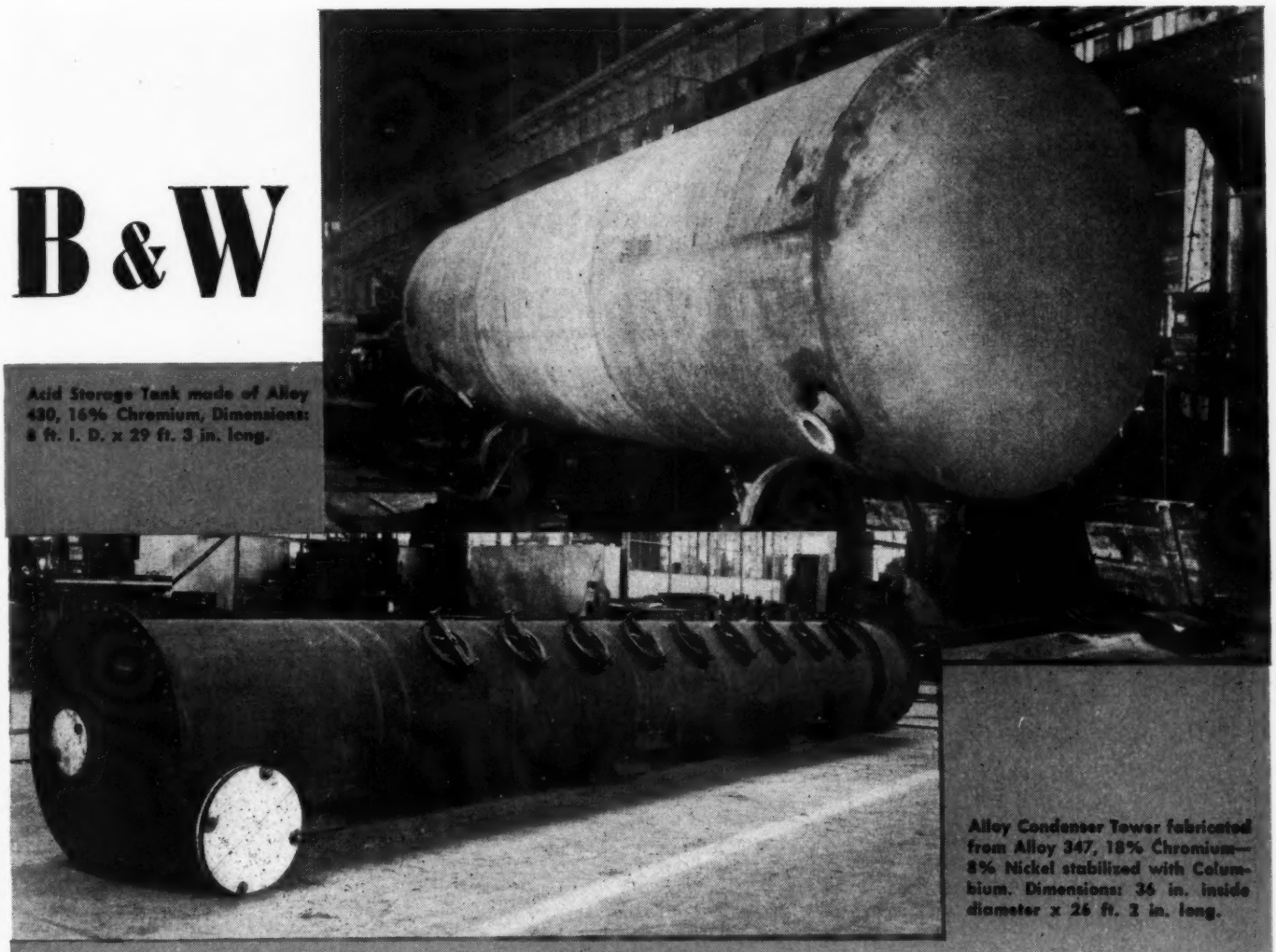


B&W



Acid Storage Tank made of Alloy 430, 16% Chromium. Dimensions: 8 ft. I. D. x 29 ft. 3 in. long.

Alloy Condenser Tower fabricated from Alloy 347, 18% Chromium—8% Nickel stabilized with Columbium. Dimensions: 36 in. inside diameter x 26 ft. 2 in. long.

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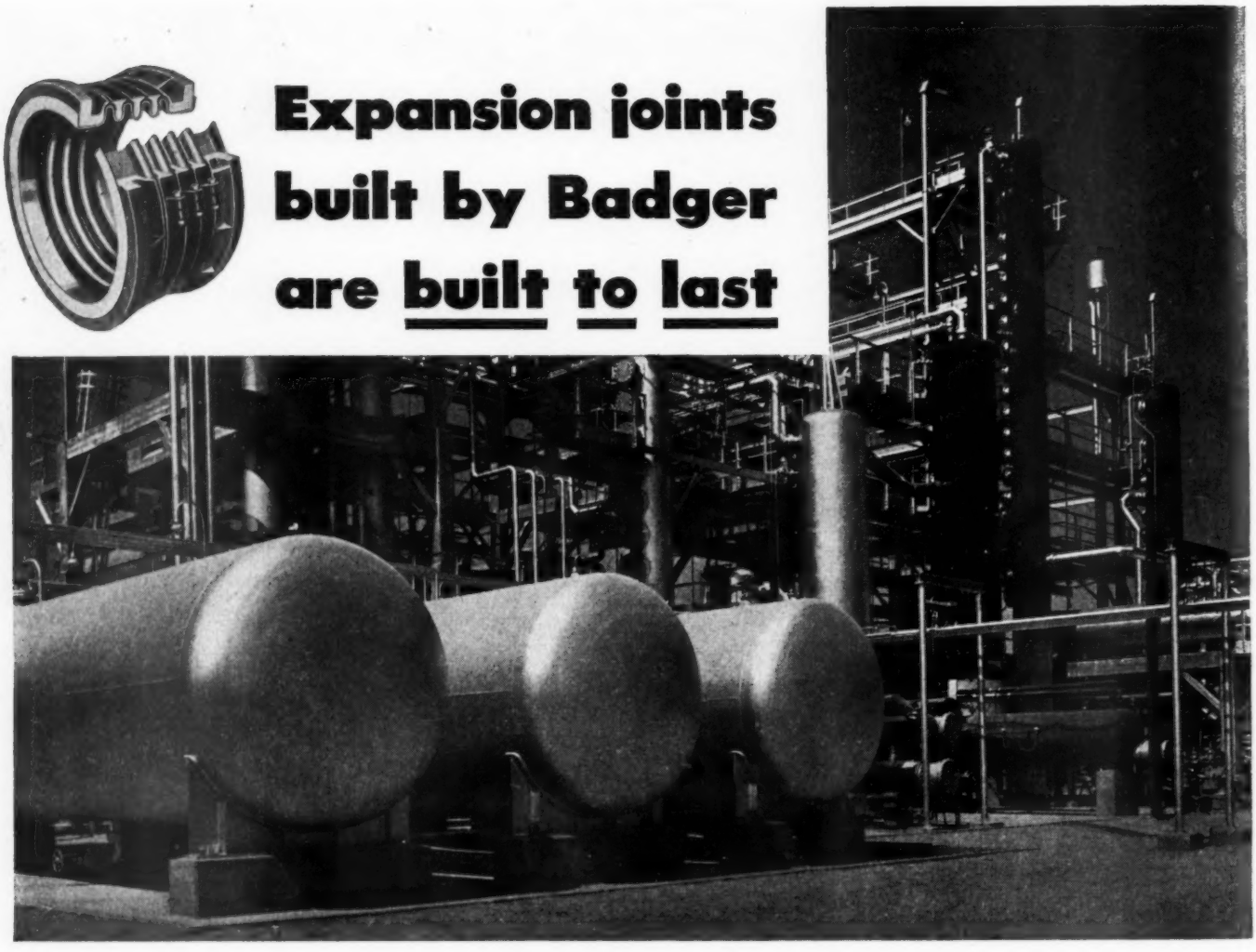

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TCC Processing of Sour Gas Oil

The accompanying article was prepared from a paper entitled "Lion Oil Co. Catalytically Processes Sour Gas Oil", prepared by W. Carney, Lion Oil Co., El Dorado, Ark., and H. D. Noll and A. W. Hoge, Houdry Process Corp., Philadelphia.

A 5400 B/D Thermofor Catalytic Cracking unit, at the El Dorado, Ark., refinery of Lion Oil Co., has been in operation for well over a year successfully charging a mixture of sour heavy gas oil and reduced crude from the Schuler, Ark., field.

This mixed charging stock averages about 1.7 wt. % sulfur content, about 25.7 deg. API gravity, and has a boiling range of 480° F. to 910° F. by vacuum distillation. Tables 1 and 2 respectively give inspections of the crude processed at the Lion refinery and of the charge stock to the TCC unit.

With a minimum of alloy protection from corrosion, the unit now gives evidence of continued performance equal to that of other commercial catalytic cracking units operating on sweet stocks, producing better than a 50% yield of 10-lb. RVP 410 E.P. gasoline which requires only a minimum of caustic treating. From the experience to date the plant operators conclude that imported crudes from Near Eastern and Venezuelan fields similar in sulfur characteristics to Schuler crude could be satisfactorily processed at the El Dorado refinery without further revisions to equipment or processing schemes.

A wide variety of operating conditions were imposed on the TCC unit at El Dorado to arrive at optimum product distribution in the overall refinery balance of products. Fresh feed throughput, recycle ratio and temperature were the variables most widely studied. After considerable exploration it was concluded that, with the feed stocks available, a low temperature operation with a nominal amount of internal recycling was most desirable.

This type of operation provided a high combined yield of 10-lb. RVP motor gasoline and 600° F. end point distillate fuel oil of about 70 vol. %. The gasoline yield is further augmented to the extent of approximately 8.0 vol. % of the virgin reactor charge by polymerization of the unsaturated portions of the C_3 and C_4 fractions. Typical TCC operating conditions and yields are given in Table 3.

After caustic treating in a regenerative system, the stabilized TCC gasoline has an average total sulfur content of about 0.10 wt.% and is doctor sweet. The stability of both the catalytic gasoline and the No. 2 fuel oil meets all marketing specifications. The end point and the pour point of the No. 2 fuel oil produced are about 600° F. and 0° F. respectively. Inspections of the various TCC product streams after gas recovery and stabilization are given in Table 4.

Sulfur balances for the Lion TCC operation were made to provide means for a study of the distribution of sulfur in the products. Typical data are presented in Table 5 which also gives typical sulfur balances for TCC operations on moderately sour and sweet charging stocks.

Although a generalized correlation of sulfur distribution in the products versus sulfur content of the charge cannot be made for stocks of widely different chemical composition (the aromatic California crudes are notable exceptions) it is noted that for most paraffinic and mixed-base stocks, about 55% of the total pounds of sulfur in the charge appears in the gas and coke products, about 42% in the cycle stock and about 3% in the catalytic gasoline.

The foregoing generalization regarding sulfur distribution is valid only at normal conversion levels of 55 to 60%, since the quantities of sulfur in the individual products depend upon the relative quantities of those products or, in other words, the conversion level. The change in sulfur distribution with change in conversion in TCC cracking is illustrated by the curves shown in Fig. 1. These graphs were developed from a large number of TCC runs made on a variety of charging stocks and over a considerable range of operating conditions. The data tabulated in Table 5 have been plotted on these generalized curves.

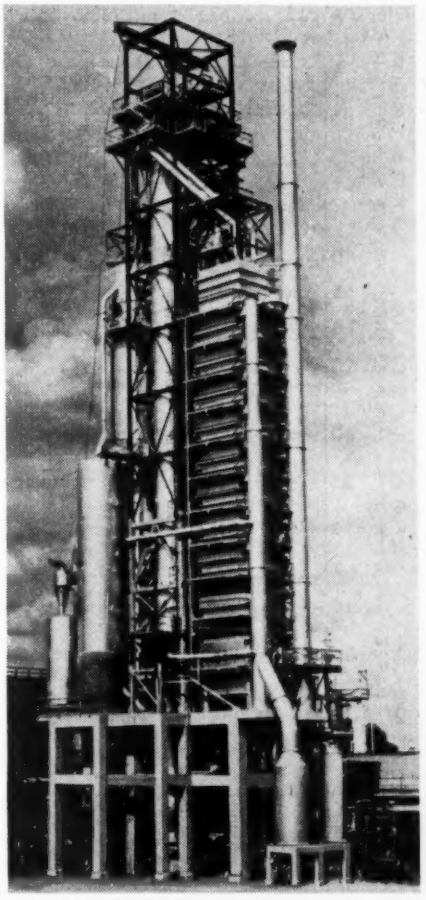
With the operation of the Lion TCC unit on sour stocks a minimum of chemical treatment of the catalytic gasoline is required to produce a non-corrosive, stable, doctor sweet product. It is generally recognized that sour stock operations involve much more elaborate finishing treatment of the products to meet marketing specifications. Prior to the in-

TABLE 1—Inspection of Crude Processed by Lion Oil Co.

Crude	Lion (Schuler)
Gravity—°API	34.5
TBP Dist., °F	
IBP	86
5%	145
10%	210
20%	300
30%	395
40%	485
50%	595
60%	695
70%	785
80%	...
Sulfur-Wt. %	1.40
Conradson Carbon-Wt. %	3.1

TABLE 2—Inspections of Gas Oil Charge to Lion's TCC Reactor

Gas Oil	Lion TCC Charge
Yield—Vol. % of Crd.	30.0
Gravity—°API	25.7
Vac. Dist. °F.	
IBP	484
10%	620
20%	670
30%	715
40%	750
50%	785
60%	825
70%	865
80%	910
Aniline Pt., °F.	165
Sulfur, Wt. %	1.7



Lion Oil Co.'s TCC unit at its El Dorado, Ark., refinery

stallation of the TCC unit at El Dorado, for example, the thermal gasoline produced from the stocks now being cracked catalytically had an average total sulfur content of 0.15 Wt.% after regenerative caustic washing and copper chloride sweetening.

The TCC gasoline, however, is given only a regenerative caustic wash and inhibited, after which the total sulfur content averages about 0.10 Wt.% and the product is sweet to the doctor test. The untreated TCC gasoline leaving the stabilizer has a total sulfur content of about 0.15 Wt.%, about one-third of which is mercaptan sulfur. The mercaptan compounds present, however, are removed almost quantitatively by a strong caustic wash so that the finished product meets the specifications quoted above. The distribution of total sulfur versus boiling range of the Lion TCC gasoline before caustic washing is typified by the data plotted in Fig. 2.

The Lion Oil Co. TCC unit consists of the conventional heater, tar separator, reactor-kiln and distillation sections. Among the latest developments incorporated in the design at the time of construction are a single, split-bucket type, hot catalyst elevator for transporting both spent and regenerated catalyst, self-supporting reactor and kiln sections, which result in an economy in the steel superstructure required, and a kiln cooling coil manifold arrangement at the first platform in the structure, which facilitates operation by permitting all coil changes to be made at this location. As far as the catalytic section is concerned, only the reactor proper has alloy protection against corrosion by the sour charging stocks. The hot catalyst elevator, kiln air blower and principal feed and product pumps are driven by steam turbines.

The catalyst used in the unit is the synthetic bead type. The normal catalyst inventory in the unit is

TABLE 3—Typical Operating Conditions and Yields for Lion's TCC Unit

Charge Data		**BPSD**
Virgin Charge to Tar Sep.		5838
Recycle Charge to Tar Sep.		908
Total Tar Sep. Charge		6746
Tar Separator Bottoms		1183
Total Reactor Charge		5563
Virgin Reactor Charge		4655
Operating Conditions		
Space Velocity (Total Charge), V/Hr./V		1.0
Catalyst/Oil Ratio (Total Charge), V/V		2.4
Top Reactor Pressure, PSIG		8.0
Oil Vapor to Reactor, °F.		860
Catalyst to Reactor, °F.		1005
Catalyst Circulation Rate, Tons/Hr.		72
Product Yields	**BPSD**	**Lbs. Hr.**
10# RVP, 410° F. E.P. Motor Gasoline	2376	
#2 Fuel Oil	855	
Heavy Catalytic Gas Oil	855	
Excess C_4's	602	
C_4 Plus Liquid Recovery		4390
C_3 & Lighter Gas		2765
Coke		
	Vol. % Virgin Reactor Chg.	**Wt. % Virgin Reactor Chg.**
10# RVP, 410° F. E.P. Motor Gasoline	51.0	
#2 Fuel Oil	18.4	
Heavy Catalytic Gas Oil	18.4	
Excess C_4's	12.9	
C_4 Plus Liquid Recovery	100.7	
C_3 and Lighter Gas		7.2
Coke		4.5

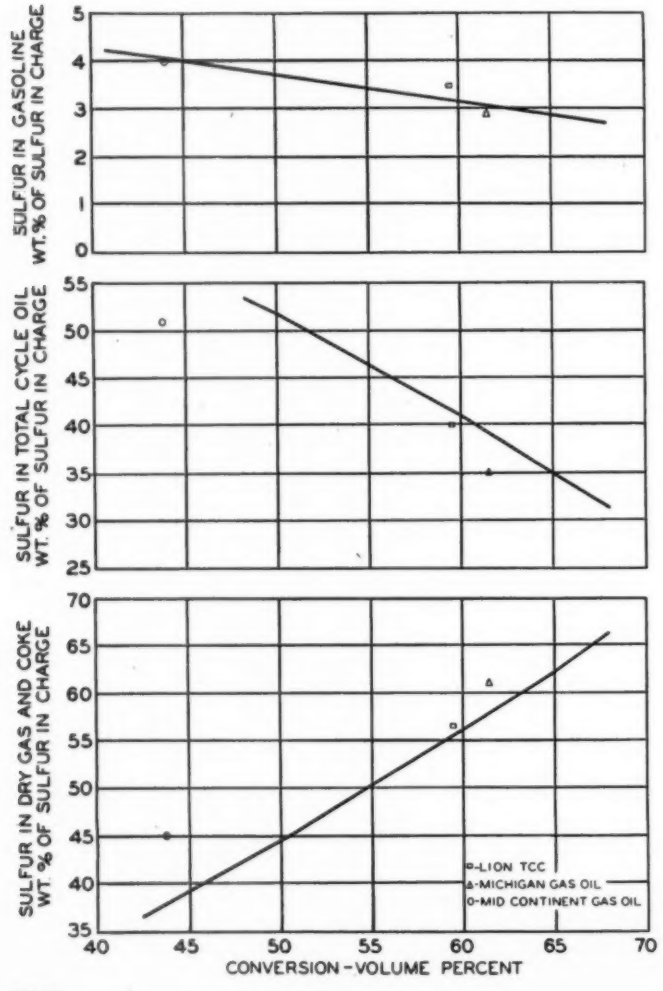

SULFUR IN GASOLINE WT.% OF SULFUR IN CHARGE
SULFUR IN TOTAL CYCLE OIL WT. % OF SULFUR IN CHARGE
SULFUR IN DRY GAS AND COKE WT % OF SULFUR IN CHARGE
o-LION TCC
Δ-MICHIGAN GAS OIL
o-MID CONTINENT GAS OIL
CONVERSION-VOLUME PERCENT

Fig. 1 (Left)—Sulfur distribution in Lion's TCC operation

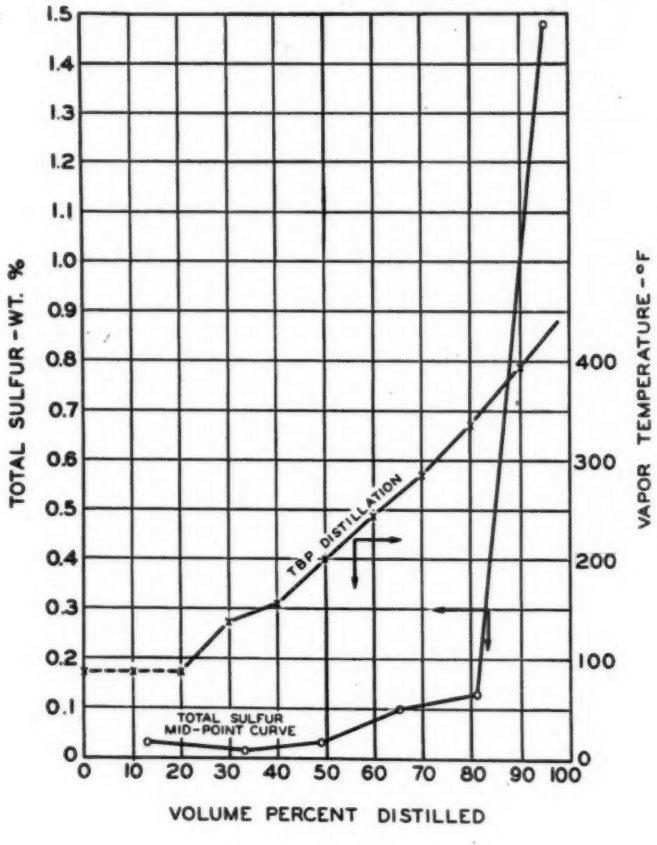


Fig. 2 (Above)—Total sulfur distribution in Lion's TCC gasoline before caustic washing

about 225 tons and the initial charge of catalyst had an activity of 42 by the Cat-A method. After the first year of operation, the average activity of the system has leveled out at about 31 Cat-A index. During this entire period of operation no catalyst has been withdrawn from the unit and replaced with fresh catalyst for the purpose of maintaining average activity.

The Lion TCC installation is composed of both new and used equipment with alloy steel protection provided only at critical locations. The vapor superheater, tar separator and the entire catalytic cracking section proper were new construction. The balance of the feed preparation distillation and recovery sections were parts of equipment previously operated in the refinery. Some of the existing equipment which was revamped for TCC service had already been provided with alloy protection for sour stock operation and, as previously mentioned, only the reaction zone of the TCC unit was alloyed. An itemization of the major pieces of equipment and the extent and type of alloy used is given in Table 6.

The unit was shut down April 4, 1948, for a complete inspection and clean-up after seven months' operation, during which time an on-stream efficiency of 97% was realized. That the off-stream time to on-stream time for the Turnaround amounted to only seven days is indicative of the excellent condition in which all of the equipment was found. A summarized report of the inspection is presented in Table 7. No piping replacements were required because of metal loss from corrosion or erosion despite the fact that, as indicated in Table 6, much of this piping was fabricated of carbon steel. For example, the vapor lines to and from the reactor are carbon steel. Undoubtedly, these lines operate at a temperature outside the critical range for corrosion by the Lion stocks. The significance of this experience, however, is that economies in the design of the plant for sour stock operation were realized by providing alloy protection at only critical locations.

TABLE 4—Inspections of the Various TCC Product Streams After Gas Recovery and Stabilization

	Stabilized Gasoline	No. 2 Fuel Oil	Heavy Catalytic Gas Oil
Gravity—°API	59.3	26.0	16.1
ASTM Dist. °F.			
IBP	90	448	613
50%	202	520	702
90%	374	571	760+
EP	408	600	
RVP	7.3		
Octanes			
M.M. Clear	80.5		
+ 3cc TEL	86.3		
Res. Clear	92.0		
+ 3cc TEL	97.2		
Sulfur-Wt. %	0.10	1.45	
Pour °F.		0	75
Aniline Pt. °F.		116	

TABLE 5—Sulfur Distribution in Lion's TCC Operation, and Typical Sulfur Balances for TCC Operations on Moderately Sour (Michigan) and Moderately Sweet (Mid-Continent) Gas Oil Charging Stocks

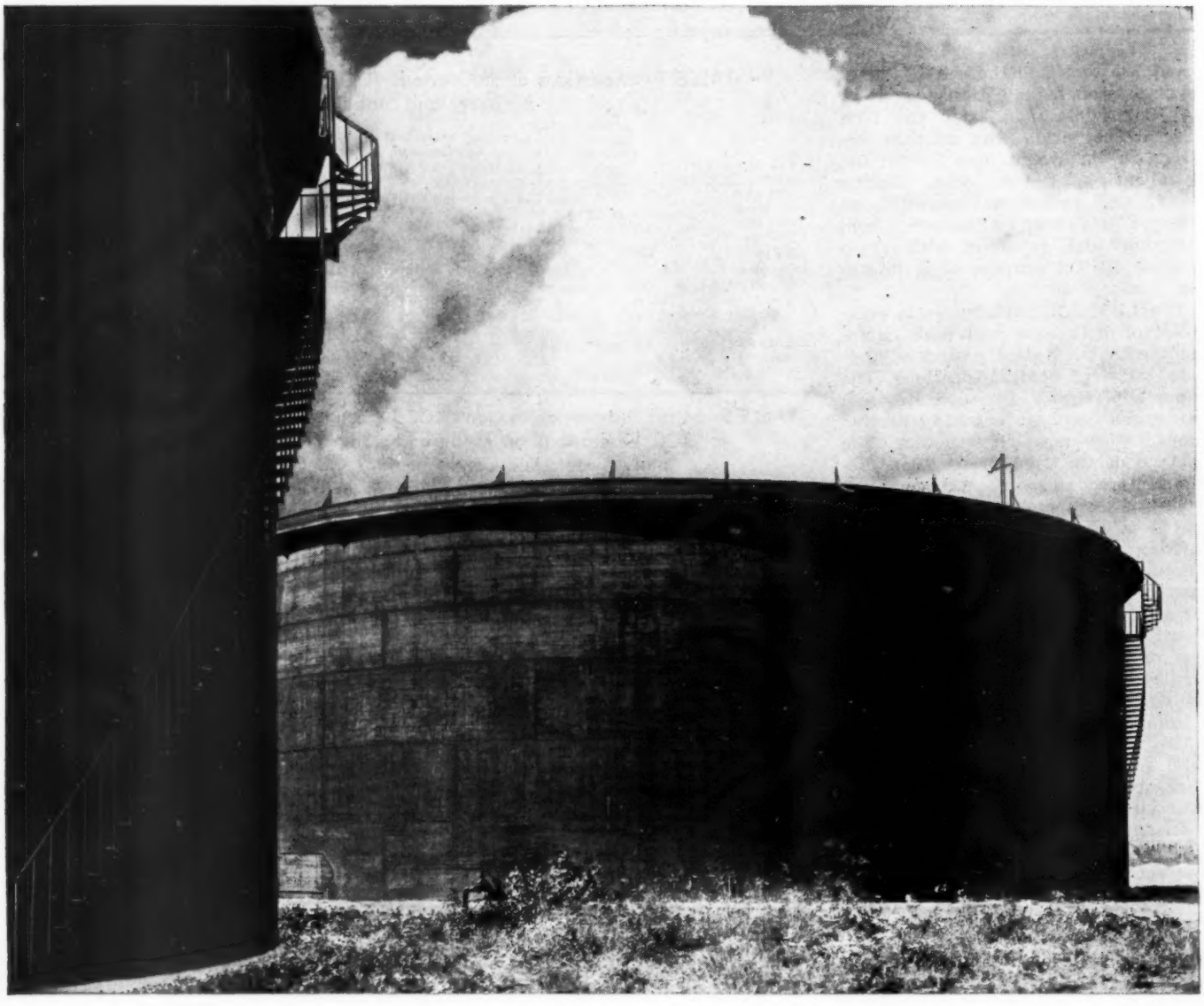
	Lbs./Hr.	Wt. % Sulfur	Lion Gas Oil Lbs./Hr. Sulfur	Wt. % of Total Sulfur
Reactor Charge	65,800	1.70	1,118	100.0
Products				
Gasoline	27,600	0.14	39	3.5
Cycle Oil	26,832	1.66	446	40.0
Gas + Coke	8,490		148	56.5
Totals	65,800		1,118	100.0
			Michigan Gas Oil	
	Lbs./Hr.	**Wt. % Sulfur**	**Lbs./Hr. Sulfur**	**Wt. % of Total Sulfur**
Reactor Charge	39,200	0.61	239	100.0
Products				
Gasoline	15,460	0.046	7	2.9
Cycle Oil	15,250	0.55	84	35.1
Gas + Coke	8,490		148	62.0
Totals	39,200		239	100.0
			Midcontinent Gas Oil	
	Lbs./Hr.	**Wt. % Sulfur**	**Lbs./Hr. Sulfur**	**Wt. % of Total Sulfur**
Reactor Charge	129,000	0.14	530	100.0
Products				
Gasoline	41,900	0.049	21	4.0
Cycle Oil	73,100	0.37	270	51.0
Gas + Coke	14,000		239	45.0
Totals	129,000		530	100.0

TABLE 6—Itemization of Major Pieces of Equipment in Lion's TCC Installation, Extent and Type of Alloy Employed, and Whether Existing (Previously Used in the Lion Refinery) or New Added Equipment

Item	Material	Existing or Added
Feed Preparation		
Vaporizing heaters	4-6% chrome tubing	Exist
Tar separator	11-13% chrome lining complete	Added
Tar separator bottoms lines	4-6% chrome pipe	Added
Tar separator vapor line & valves	Carbon steel	Added
Vapor superheater	2% chrome tubes	Added
	4-6% chrome headers	Added
Vapor line to TCC reactor & valves	Carbon steel	Added
Reactor		
Reaction zone	11-13% chrome lining	Added
Reactor internal elements	18-8 stainless	Added
Reactor vapor outlet lines & valves	Carbon steel	Added
Synthetic Crude Tower		
Synthetic crude tower	11-13% chrome lining in lower half—upper half carbon steel	Exist
Synthetic crude tower piping	Carbon steel	Added
Exchanger	Carbon steel	Exist
Synthetic crude tower overhead condensers	Carbon steel shell Admiralty metal tubes	Added
Overhead receiver & gas sep.	Carbon steel	Exist
Kiln		
Kiln internals	Conventional 4-6% chrome air and flue gas distributors & collectors—2% chrome water tubes	Added

TABLE 7—Summary of Inspection of Lion TCC Unit During Routine Shutdown after Seven Months' Operation

Item	Condition
Feed Preparation	
Oil charge lines & exchangers	Excellent—no metal loss
Vaporizing heater tubes	Excellent—no metal loss
Tar separator	Alloy lining good except for one broken strip weld
Tar separator bottom lines	Excellent—no metal loss
Tar separator vapor line	Good—no metal loss
Vapor superheater tubes	Good—no metal loss
Vapor line to reactor	Good—no metal loss
Synthetic Crude Tower	
Synthetic crude tower	Tower clean—lining in good condition
Synthetic crude tower piping	Excellent—no evidence of corrosion
Overhead condensers	Good—no fouling or evidence of sulfur attack on admiralty metal tubes or carbon steel shell
Overhead receiver	Good
Reactor	
Reactor shell	Excellent—alloy lining good except for six broken strip welds
Reactor internals	Excellent—no evidence of erosion or corrosion
Reactor vapor line & valves	Excellent—no evidence of corrosion
Kiln	
Suspended tile lining	Excellent—no erosion or spalling
Air and flue gas distributors	Excellent
Cooling coils	Good—very slight scaling on inside
Catalyst piping	Excellent—no replacement required
Hot Catalyst Elevator	
General Condition	Excellent — indicated chain life 3 years
Traction Rims	0.049 in. max. wear
Chain Links	0.237 in. max. wear
Chain Knuckles	0.078 in. max. wear



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If filling losses far exceed standing losses in your storage installation, the Graver Improved Floating Roof *with full double deck* is your best protection. It's designed to prevent all the filling losses *plus* as high as fifty percent of the standing losses . . . the greatest possible overall saving for such set-ups as a deep water terminal.

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TUBULAR HEAT EXCHANGERS— "In-Place" Methods for Cleaning

By P. F. DOUGHERTY and C. H. BROOKS, Engineering Division
Manufacturing Dept., Sun Oil Co.

*Various methods available for cleaning tubular heat transfer equipment in the refinery are discussed, with particular emphasis on the use of an emulsifying oil for "in-place" cleaning, and on the use of sand-blasting. The relative merits of the "in-place" and the mechanical methods are outlined, as well as the factors to be considered in selecting a particular procedure for a given application in the refinery**

CLEANING methods for tubular heat transfer equipment fall into two general classes. The first class consists of those methods which perform the cleaning without dismantling the equipment, by means of the circulation of a solution which chemically and/or physically removes the fouling material. The second class includes all those methods where the equipment is partially or wholly dismantled, and the fouling agent removed by a purely mechanical means.

The adaptability of the "in-place" methods must be determined by physical and chemical examination of the fouling substance. Laboratory solubility tests must also be made of the material. A plant scale test under close supervision should then be made, if it be found in the laboratory that a significant portion of the fouling material be soluble.

In order that equipment may be cleaned in place the fouling material must be capable of removal by one of the following methods:—

1) Chemical reaction with, and subsequent solution in, an acidic or alkaline solution.

2) Solution of a portion of the fouling material (i.e. a binder) in the cleaning fluid, thus permitting the undissolved portion to be flushed out. The cleaning fluid may be hot or cold water or acidic or alkaline solutions. The flushing agent may be the cleaning fluid used or another liquid or emulsifying oil.

3) Suspension of the fouling agent in the cleaning fluid.

4) Complete solution of the fouling agent or of the binder in an organic solvent.

5) Combinations of the above methods.

Sun Oil Co's. experience indicates that cleaning in place has the following advantages:—

1) Down-time for equipment is reduced.

2) Dismantling of equipment with resultant damage and high labor cost, is avoided. In those cases where tube bundles cannot be removed, no other methods are available for cleaning the shell side.

3) Cleaning is more thorough. The solution will clean parts which would be difficult or impossible to reach with cleaning tools.

4) Cleaning is more uniform. There are no small particles of scale remaining on the surface. On the contrary, mechanical cleaning usually leaves small particles of scale on the surface, which act as nuclei for the rapid formation of new scale.

5) There is practically no loss of metal.

6) The metal surface is left smooth in contrast to mechanical cleaning which frequently results in scoring which provides a place for lodgment of fouling material.

As pointed out above, laboratory tests should be made to determine the feasibility of the use of a particular "in-place" method. This work should be followed by closely supervised plant scale tests to confirm the laboratory results and to develop the actual procedure to be followed, if the method be adopted.

Our experience has indicated that the normal procedure of steaming the equipment for extended periods prior to cleaning, should not, as a rule be followed when cleaning in place is planned. In one case it was found that the tubes appeared almost clean when the equipment was opened without steaming, whereas they were almost completely plugged with a rubbery mass, after steaming for several hours. Prolonged steaming, in most instances, results in the removal of the more volatile components of the fouling material and the production of a residuum which is far less soluble than the original fouling substances.

Prior to the adoption of an "in-place" method of cleaning a particular piece of tubular equipment, investigation should be made to determine if—

1) There be evidence of severe corrosion or deep pitting. The removal of the scale may uncover actual perforations in the tubes, which are plugged with scale.

2) In the course of normal service, any portion of the tubes becomes plugged completely. If such be the case, the equipment must be opened and the tubes unplugged prior to "in-place" cleaning. Otherwise, the solution will be unable to contact the fouling material, and the equipment will not be thoroughly cleaned.

Solution Cleaning

The use of inhibited acid has been described and discussed at length previously. Sun Oil has found that the use of this technique is most advantageous on the water side of coolers. It should be noted that in at least one instance, the fouling material was only partly soluble in the acid. The solution of this portion, apparently acting as a binder, permitted the remainder to be flushed out by the circulation of the acidic solution.

An alkaline solution was used to clean certain exchangers in a solvent refining unit, with the results shown in Table 1. An abnormally high circulation rate is believed to have assisted the cleaning in this case. In addition no steaming was used prior to cleaning.

A second example of the efficacy of dissolving a binder in the fouling material is given by a set of gas oil-crude exchangers in a catalytic cracking unit, which were fouling rapidly on the crude side. Steaming out had proven unsatisfactory to remove the fouling material which was approximately 70% salt, with balance insoluble organic and inorganic material. Circulation of boiling water at a very low rate produced the results shown in Table 1.

The use of an emulsifying oil, available in our refinery, is applicable

* This article is a principal portion of a paper by the above authors, entitled "Cleaning Tubular Heat Exchangers," and presented at the New York meeting of the American Society of Mechanical Engineers, Nov. 29, 1948.

where the fouling material is (a) completely soluble in the oil or (b) can be held in suspension in the oil, and thus removed from the equipment.

This method was primarily developed for the cleaning of the oil (shell) side of absorption oil coolers. The fouling material was an emulsion with a grease-like consistency, composed of water, oil, resins and inorganic solids. The use of heat or solvents broke this emulsion, allowing the resins and inorganic solids to settle out behind the baffles where they could not be removed by flushing with water or high or low viscosity oils. Experience indicated that the presence of these solids accelerated the formation of the emulsion after cleaning. Hence a method to remove both the emulsion and the solids was required. Experiment indicated that mixing concentrated emulsifying oil (i.e. without dilution with water) with the fouling emulsion and then heating to obtain the desired fluidity, would permit these objectives to be attained.

After isolation of the equipment, the oil (shell) side was filled with emulsifying oil. The oil was heated to approximately 150° F. and circulated until there was no change in the appearance of material entering the circulating tank. Circulation was then stopped and the contents of the shell heated until a pressure of 50 psig. was reached. The contents of the shell were then blown through the drain valve into the circulating tank. After washing with water, the unit was drained and returned to service. The improvement is indicated in Table 1.

Substantially the same procedure was followed in cleaning the feed bottoms exchangers on a light gasoline distillation tower, with the result shown in Table 1.

When the various "in-place" methods prove to be inadequate, resort must be made to the mechanical methods which include:

1) Lancing with air, steam or water.

2) Drilling or "rodding" the obstructive material from the tubes.

3) Sand Blasting.

All of the above methods require that the exchanger be at least partially dismantled for cleaning, as distinct from the "in-place" methods, where any dismantling is for inspection purposes only.

The selection of the method depends on the nature of the fouling material. It should be noted that it is decidedly advantageous to steam both the tube and shell sides for as long as time will permit, prior to mechanical cleaning. This steaming removes the tarry or oily components of the fouling material, thus increasing the effectiveness of a given cleaning method.

The discussion below is confined to cleaning the *tube* side of tubular heat exchangers.

The general method of lancing employs a relatively small high velocity jet of steam or air and occasionally water. It is applicable only when a) a low percentage of the tubes are completely plugged, b) the fouling material is not tightly bound to the tubes, and c) the fouling agent is not of a gummy or tarry nature.

Drilling and rodding consist of forcing a closely fitting rotating drill or a closely fitting rod through the tube. These methods are used when a) a high percentage of the tubes are completely plugged, b) preliminary steaming leaves considerable tarry or gummy material in the tubes, or c) if the fouling material is tightly bound to the tubes (drilling only).

These two methods have certain serious disadvantages which are common to any method, e.g. wire brushing, which in essence scrapes the fouling material from the surface. These disadvantages include:

1) Excessive down-time and labor costs.

2) Frequently a necessity for removing the tube bundle before it can be cleaned.

3) Metal loss as a result of cleaning is excessive and/or unevenly distributed. Scoring of the tubes, which sometimes occurs, seems to accelerate the fouling rate.

4) Small amounts of the fouling agent are left on the tube surface, which act as nuclei for the rapid build-up of the fouling agent.

Sand blasting can be used to clean the inside of either steel or admiralty tubes when the fouling material is not removable by any of the previously discussed methods. Such fouling material is, in most cases, composed of mixtures of tars, resins, inorganic solids, and carbon. Its physical and chemical nature is such that an insufficient amount will dissolve in any of the solvents or solutions outlined above to permit the scale to be removed.

The procedure which has been followed successfully, with no measurable metal loss, is as follows:

1) After isolation and draining of the exchanger, it is steamed for at least six hours, and longer if possible, to vaporize, or solidify any oily, tarry, or gummy materials. Otherwise, the sand will tend to stick to the surface, thus reducing its effectiveness.

2) The exchanger is opened, and any plugged or partially plugged tubes are opened by lancing, drilling or rodding. To effectively use the sandblast an opening through the entire tube length, large enough to allow free passage of sand, is required. In general, the harder or more brittle the scale, the smaller may be the opening.

3) Sand blast the tubes. It has been found that ordinary labor, with reasonable care, can satisfactorily perform this operation without special equipment.

4) Excess sand is blown from the tubes, the tubes inspected, and the unit closed and returned to service.

It should be emphasized that we have not found a measurable metal loss in a sandblasted tube. Sandblasted tubes have been removed from bundles, split longitudinally and found to have a wall thickness over their entire length which was within normal manufacturing tolerances.

It is our opinion that the heat transfer in a sand blasted tube equals that for a new tube. In addition qualitative, and scanty quantitative data indicate very definitely that, in many cases, the fouling rate is less for a sand blasted tube than for one cleaned by more conventional mechanical methods.

In our opinion, sandblasting as a supplementary procedure, should be considered when rodding, drilling, etc. are the primary cleaning methods required.

Note: The use of emulsifying oil as a cleaning agent for tubular equipment is covered by an application for U. S. letters patent.

TABLE 1—Results of "In-Place" Cleaning of Heat Exchangers

Example	Solvent Refining Unit Exchrs. A	Gas Oil Crude Exchrs. B	Abs. Oil Exchrs. C	Gasoline Feed-Btms Exchrs. D
Cold End Temp. Difference °F.				
Before Cleaning	185	..	46	40
After Cleaning	146	..	2	12
Design		..	5	30
Hot End Temp. Difference °F.				
Before Cleaning	155	..	115	91
After Cleaning	94	..	91	75
Design		..	38	35
Overall Coefficient Btu/H12/Ft²/°F.				
Before Cleaning	13.5	16	7.2	36.4
After Cleaning	37.0	46	30.2	51.1
Design	42.5	..	35	60
Pressure Drop, psi				
Before Cleaning	...	..	..	90
After Cleaning	...	..	..	20

stop razing the roof because of sour crude corrosion

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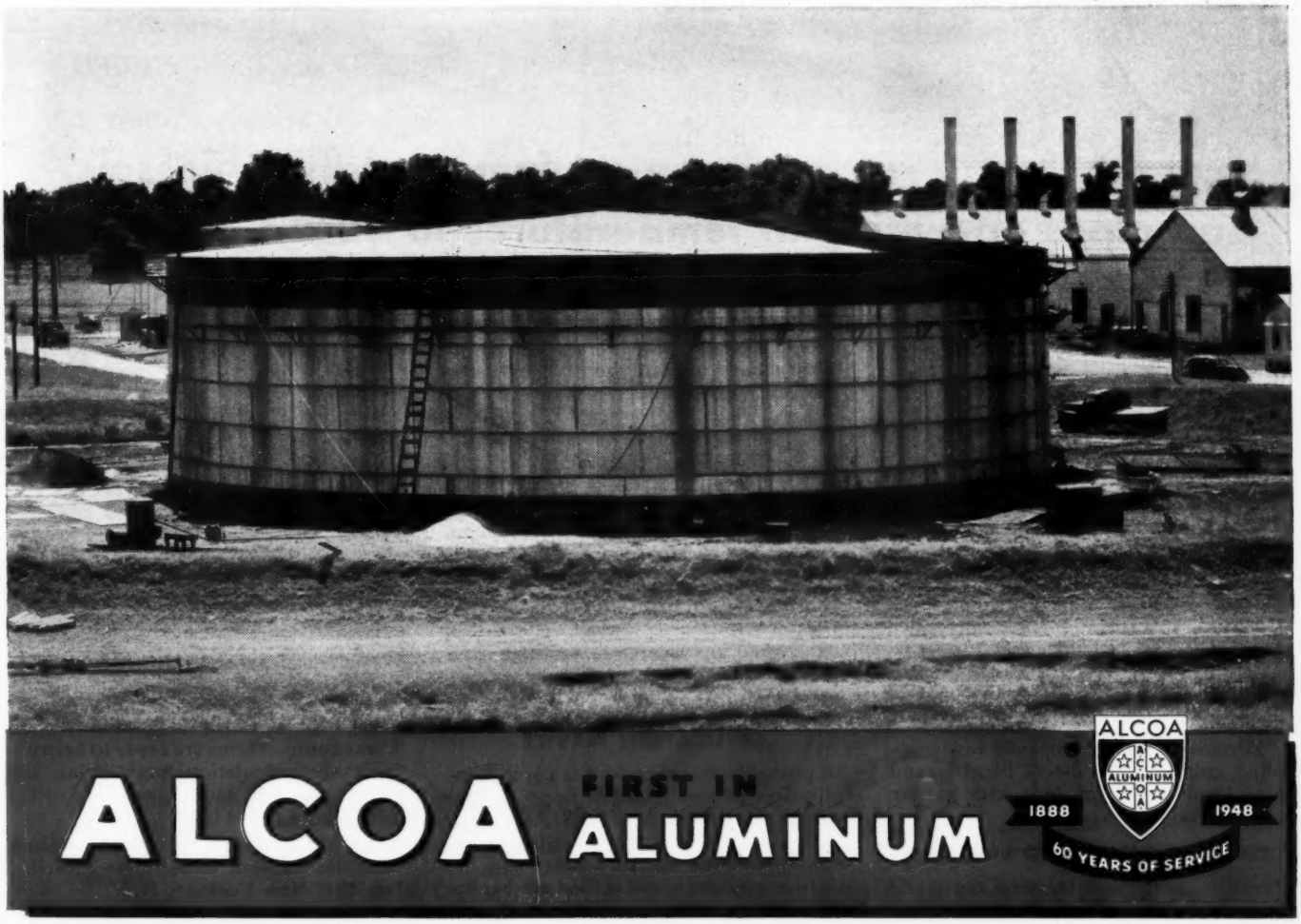

Johns-Manville Announces

For insulating refrigerating equipment, tanks, vessels, and pipes operating at temperatures to 400° below zero

FOR MORE THAN 75 YEARS, insulations by Johns-Manville have kept pace with the scientific and engineering advancements of industry. Now the Johns-Manville Research Laboratory has developed Zerolite*, an entirely new inorganic refrigeration insulation.

Zerolite is recommended for use in industrial locations where the fire problem is particularly dominant and where solvent fumes may cause costly deterioration of the insulation. It is recommended for use where a dependable insulation with low heat conductivity is important in keeping a system operating economically at constant low temperatures.

Zerolite is easily worked, easily applied, and comes in sheets, lagging, and pipe insulation form, in a wide variety of sizes and thicknesses.

ZEROLITE SHEETS AND LAGGING

Zerolite sheets and lagging are made from mineral wool and a resin binder. A special J-M process disperses the resin binder over the mineral wool fibers, resulting in an insulation with exceptional moisture resistance.

ZEROLITE PIPE INSULATION

Zerolite pipe insulation is manufactured from the same materials as the sheets and lagging, but is further provided with an asphalt-saturated jacket that protects both longitudinal joints. The jacket reduces the need for seam-filling compounds and shortens application time because on smaller size lines complete sections can be applied as units. Zerolite Pipe Insulation is furnished with all accessories required for application.

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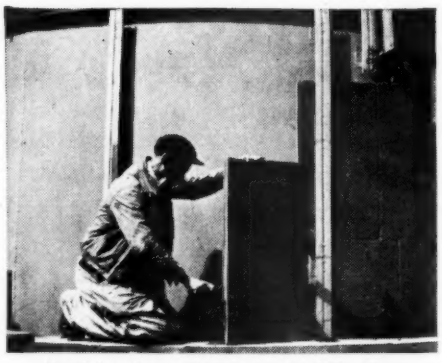
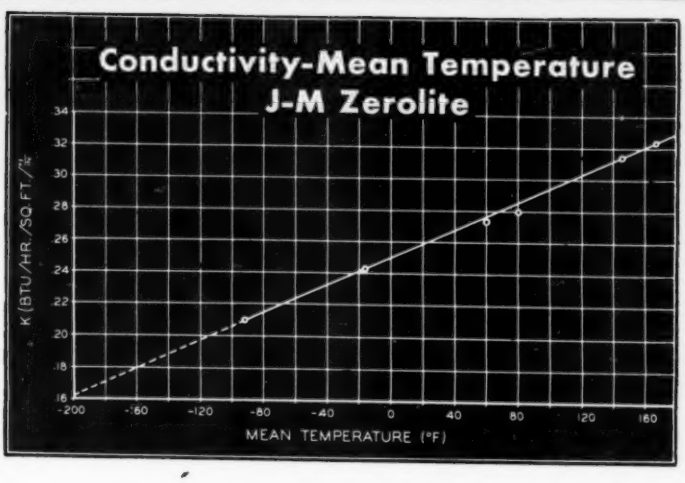


Applying fire-resistant sheets of Zerolite Insulation on oil storage tank.

For further information about Johns-Manville Zerolite write Johns-Manville, Box 290, New York 16, N. Y.

*Reg. U. S. Pat. Off.



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- Refrigerant lines
- Cold oil piping
- Brine lines
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Cohesive strength, lb. per sq. ft.	Compression, in. (load, 500 lb. per sq. ft.)	Water absorption percent by volume (submerged 24 hr.)	Moisture absorption in air (75 percent relative humidity, 96 hr.)
300.	0.030	2.0	0.0

Modulus of rupture, psi	Thermal Conductivity (MEAN TEMP.) 70°F	0°F	-70°F	Combustibility	Average weight, lb. per cu. ft.	Specific Heat	Coef. linear change with temp.
40.	.28	.25	.22	Fire-resistant	15.	0.30	2.0×10^{-6}

Johns-Manville ZEROLITE

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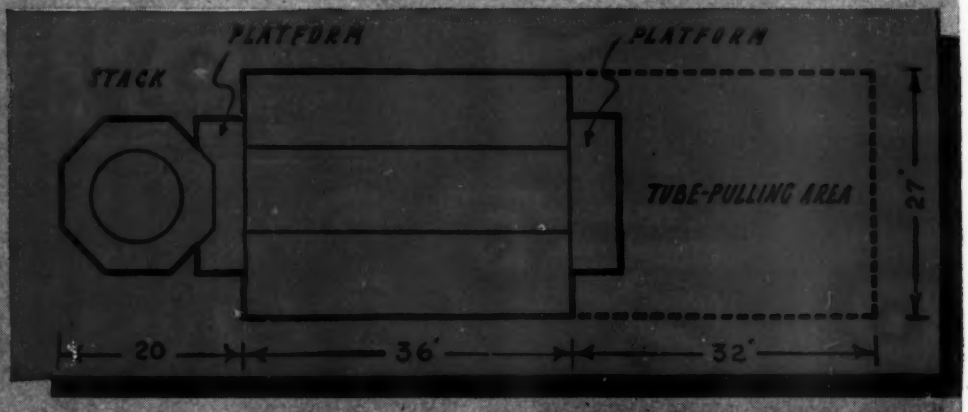
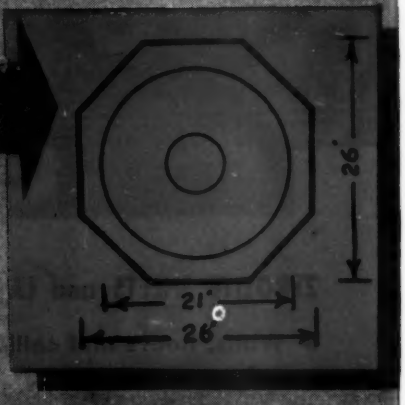
PETRO-CHEM ISO-FLOW FURNACES ARE PRE-EMINENT WHERE GROUND SPACE IS A FACTOR . . . . . *and it always is!*

Ground space plan for average box-type furnace of 50 million BTU/hr capacity



THE SAVING IN GROUND SPACE IS OBVIOUS!

Ground space plan for average Petro-Chem Iso-Flow Furnace of 50 million BTU/hr capacity



Did you ever try to cramp additional equipment into the confines of an existing refinery, or plan the layout of equipment for a new plant . . . if you did, you know the importance of every square foot of ground space.

Compare the ground space required for a box-type furnace (including the necessary space for tube-pulling, stack and platforms) with that of a Petro-Chem Iso-Flow Furnace of identical capacity. The net saving of space is considerable.

The vertical design of the Iso-Flow Furnace eliminates the need of ground space for platforms, stack and tube-pulling.

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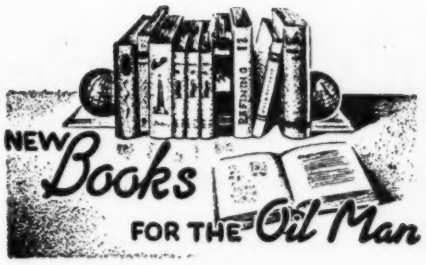


Copies of all books reviewed here may be ordered from the Reader's Service Department, Petroleum Processing, 1213 West Third St., Cleveland 13, for the price listed, postpaid, unless indicated otherwise. Ohio purchasers please add 3% tax

Bell Writes Needed New Volume On Oil Shales and Shale Oils

Oil Shales and Shale Oils, by H. S. Bell; 5¾ x 9 in., 165 pages, indexed, illustrated, stiff cloth binding, $4.00.

At this time, when sources of petroleum hydrocarbons are being explored, studied, and investigated from every angle and in every phase both by the federal government and by private industry, *Oil Shale and Shale Oils*, which treats with one of the more important sources, is indeed a welcome book to the petroleum technologist.

Completed late this past summer, the book presents existing information on the methods and economies of producing oil from shale. The oil shale sources of the entire world are discussed, including data fast becoming obscured behind Russia's "Iron Curtain." Topics covered in the nine chapters include geographical distribution and history of exploitation, characteristics of shale and shale oils, open-cut and underground mining methods, safety, preparation of shale rock, retorting, refining, and economics.

Author Bell is well-known for his *American Petroleum Refining*. He is a member of the American Society of Mechanical Engineers, American Institute of Mining and Metallurgical Engineers and the American Petroleum Institute.

Heat Conduction Text Has Value For Engineering Applications

Heat Conduction, with Engineering and Geological Applications, by L. R. Ingersoll, O. J. Zobel, and A. C. Ingersoll; 6 x 9 in., 290 pages, stiff cloth binding, illustrated, indexed, $4.00.

A number of chapters in *Heat Conduction* should be of value to refinery equipment engineers. As the title of the book indicates, it discusses the theoretical calculations and methods involved in heat conduction as applied to a variety of specific applications. Noteworthy among these are furnace walls and furnace insulation, covered steam pipes, gas-turbine cooling, electric welding, heat losses in cylindrical tanks, and the like. In the main, however, the book deals in problems not particularly related to the petroleum industry.

A feature of particular interest to those whose interests are practical is a chapter presenting graphical and approximate methods for solving practical heat conduction problems and involving only simpler mathematics. For intelligent reading of the volume on the whole, however, a reasonable knowledge of the calculus is a prerequisite.

The book is a successor to, and a revision of, an earlier text, *Theory of Heat Conduction*, by Ingersoll and Zobel. Two of the collaborating authors of the present volume are associated with the University of Wisconsin: Leonard R. Ingersoll is professor of physics and Alfred C. Ingersoll is instructor in civil engineering. The third author, Otto J. Zobel, is a member of the technical staff of the Bell Telephone Laboratories, Inc., New York.

Tractor Fuels Forum Covered In New A.S.T.M. Publication

Forum on Tractor Fuels; American Society for Testing Materials Special Technical Publication No. 82; 6 x 9 in., 43 pages, heavy paper cover, $1.00 (To ASTM members, 75c).

This new ASTM publication contains the papers and discussions presented at a *Forum on Tractor Fuels* sponsored by Technical Committee L on Tractor Fuels of ASTM Committee D-2 on Petroleum Products and Lubricants, and held in Chicago, January 9, 1948.

Subjects covered are: "Tractor Statistics as Related to the Farmer," "The Farmers' Interest in Tractor Fuels," "A Review of Tractor Requirements as Related to Fuels," "The Complexity of Tractor Fuels and Taxation," and "The Effect of State Tax Regulation and State Specifications on Tractor Fuels from the Petroleum Industry Viewpoint."

MEETINGS . . . for the Oil Man

DECEMBER

9, Chemical Market Research Assn., Toronto, Canada.

12-13, American Chemical Society, 3rd Southwestern Regional Meeting, Houston.

29-30, American Chemical Society, Division of Industrial and Engineering Chemistry, Symposium on Heat Transmission, Chicago.

JANUARY, 1949

10-14, Society of Automotive Engineers, Annual Meeting and Engineering Display, Book-Cadillac Hotel, Detroit.

FEBRUARY, 1949

10, Chemical Market Research Assn., Biltmore Hotel, New York.

28-Mar. 4, American Society for Testing Materials, Spring Meeting and Committee Week, Hotel Edgewater Beach, Chicago.

MARCH, 1949

28-April 1, Petroleum Division American Chemical Society, San Francisco.

APRIL, 1949

4-7, Refining Division, American Petroleum Institute, Shamrock Hotel, Houston.

13-15, National Petroleum Assn., Hotel Cleveland, Cleveland.

List of Films on Training Is Compiled by the A.P.I.

A Catalogue of Films Applicable to Petroleum Refinery Training, 1st Edition; 8 x 10½ in., 200 pages, heavy paper binding, $3.00.

This compilation by the American Petroleum Institute's Division of Refining of all available films suitable for training in refining operations lists some 1300 films. Each listing gives the title, description, a short review, and the source and terms of availability of each film. Films are grouped by subject. A subject index, alphabetical index, source index, and glossary of terms and abbreviations are most helpful. In addition, a list of film libraries is included.

The book was published as a result of considerable demand by the industry and made possible through voluntary donations from throughout the industry during 1947. The catalogue does not attempt to evaluate or recommend films.

ASM Publishes First Revision Of Metals Handbook since 1939

Metals Handbook, 1948 *Edition*, edited by Taylor Lyman; 8 x 10 in., 1444 pages, stiff cloth binding, indexed, illustrated, published by the American Society for Metals, $15.00.

The first revision of the *Metals Handbook* since 1939, this new edition brings together in reference form a considerable amount of information on metals held in abeyance during the war years.

It is divided into four sections: general, including summaries of wear, oxidation, stress corrosion, and service failures; ferrous metals, covering manufacture, fabrication, structural properties, welding, heat treating, etc.; nonferrous metals, including for the first time data on corrosion among other properties; and constitution of alloys, including an extensive collection of alloy phase diagrams.

The book is about 40% larger than the previous edition, and has an excellent, easy-to-use index with as little cross-referencing as was practical.

Patent Trends in Petroleum Refining

By PETER J. GAYLOR

Patent Attorney and Editor "The Technical Survey"

Fluid Catalyst Technique Applied to Hydroforming

HYDROFORMING IS DEFINED as a catalytic operation carried out in presence of a reforming catalyst, such as a Group VI oxide supported on active alumina, and in the presence of added hydrogen, the principal chemical reaction being one in which dehydrogenation of hydrocarbons takes place, but is also accompanied by certain other reactions such as isomerization, polymerization, and the like.

Until recently, all catalysts used in hydroforming have been subject to oxidation and reduction. Hydroforming is a cyclic process, that is, the catalyst is alternately used for reaction, then regenerated. The result is that the catalyst is oxidized during regeneration and reduced during the reaction period (actually during the purging with hydrogen-containing recycle gas just preceding each reaction period). This is evidently the result of oxidation and reduction of the activating metal oxide. For example, in the case of a molybdenum oxide-alumina catalyst the reaction that takes place may be represented as follows:

$$MoO_3 + H_2 \rightarrow H_2O + MoO_2$$
(during hydroforming)

and

$$MoO_2 + \tfrac{1}{2}O_2 \rightarrow MoO_3$$
(during regeneration)

Actually, the reactions may be somewhat more involved than shown. One result of this alternate oxidation and reduction is that air is required during the regeneration over and above that used up in burning coke formed during the reforming phase. In the case of a typical molybdenum oxide-alumina catalyst this additional amount of air is 50-100 cu. ft. per cubic foot of catalyst. In the case of certain chromium oxide-alumina catalysts tested, the excess air amounts to 175 cu. ft. per cubic foot when the catalyst is freshly prepared and 40-50 after use. The molybdenum oxide type catalysts are generally used in hydroforming and we shall confine the remaining discussion to this kind for purposes of illustrating. The amount of air required in excess of that required for burning coke over a given period of time will depend on the length of cycle employed. The more frequently the catalyst is regenerated, the more excess air will be required. If a typical cycle length and feed rate, 8 hrs. (4 hrs. reaction and 4 hrs. purging and regeneration), is used and the feed rate is 0.65 volumes of feed per volume of catalyst per hour, it is found that the 50-100 cu. ft. of air per cubic foot of catalyst is equivalent to the air needed to burn 0.2-0.4 wt. % carbon (as coke) based on feed. It is readily seen that if the reaction period is decreased, this coke equivalent of the excess air in terms of feed stock increases because less oil is fed per reaction period. For example, decreasing the reaction period from 4 hrs. to 1 hr. would increase the coke equivalent of the excess air required to 0.9 to 1.8 wt. % on feed. This is very appreciable in comparison with the 0.1-0.3 actual wt. % coke ordinarily formed when operating to make toluene from a feed containing methylcyclohexane. Under more severe conditions actual coke may amount to as much as 2.0-3.0 wt. % on feed, however.

In U.S. Patent 2,447,043, Standard Oil Development Co. discloses a fluid catalyst hydroforming technique employing a catalyst containing an alkaline earth oxide such as calcium oxide. By the inclusion of this oxide in the molybdenum oxide-alumina catalyst in approximately 1:1 mole ratio of calcium to molybdenum, the alternate oxidation and reduction is essentially eliminated, which factor is the one making fluid operation possible, since otherwise the coke equivalent of the excess air required would be from 11-22 wt. %, based on the feed.

Since the new type catalyst is not reduced, it is not necessary to reoxidize it during regeneration. A spinel type compound, such as zinc aluminate (or zinc spinel) is also preferred as the catalyst support or carrier, and this material increases the cyclicizing action of the catalyst so that not only are naphthenes in the feed converted to aromatics, but also paraffins are cyclized or aromatized and converted to aromatics.

Fig. 1 illustrates the manner in which the process is carried out. Powdered catalyst composed of 10% by weight of molybdenum oxide, and about 4% by weight of calcium oxide (chemically combined with the molybdenum oxide), and the balance (86%) being active alumina, the catalyst having a particle size of 20-30 microns, is withdrawn from storage hopper 1 and discharged into standpipe 3 which carries a number of taps 5 by means of which a gaseous material is injected for the purpose of fluidizing the down-flowing pow-

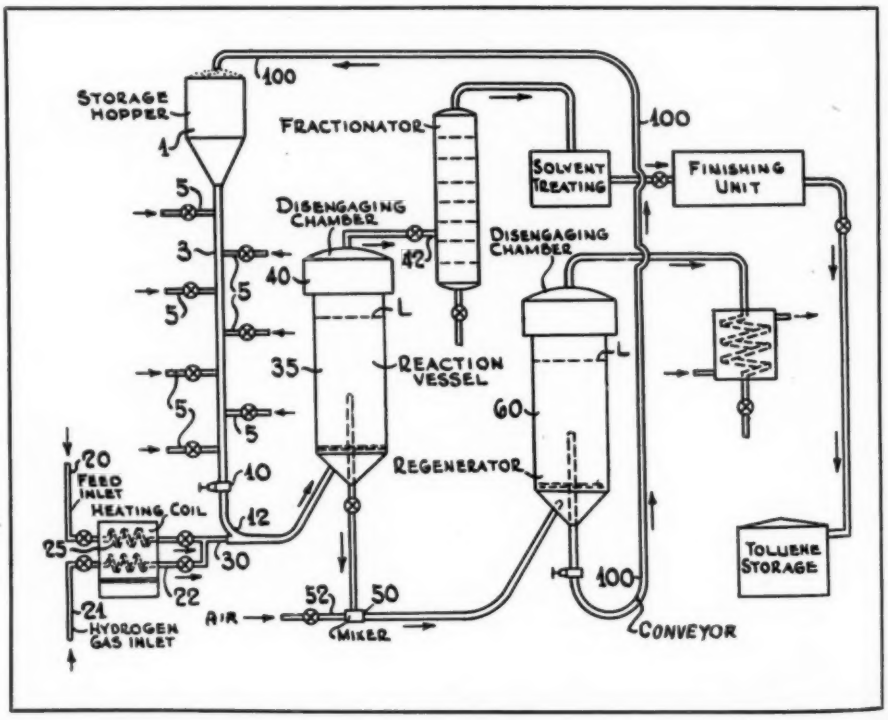


Fig. 1—Flow diagram of fluidized technique as applied to hydroforming by Standard Oil Development Co. (U. S. Patent 2,447,043)

dered catalyst, the flow of catalyst being controlled by valve 10.

A naphtha fraction which is to be converted to toluene, containing 60-70% naphthenes, boiling in the range 200-240° F., is introduced through line 20 into fired coil 25 where it is heated to a temperature of 500° F. and discharged into bend 12 of standpipe 3. Hydrogen is also introduced through line 21, heated in separate coil 22 and discharged into line 30.

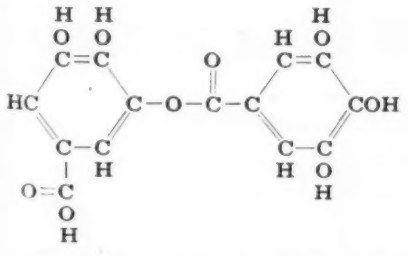
The fluidized mass is discharged from the standpipe into reactor 35 at a superficial gas velocity of 1.5-3 ft./sec. whereupon there is formed within the reactor a dense, fluidized mass having the flow characteristics and static pressure of a fluid, like water, weighing 15-40 lbs./cu. ft. The reactants pass through disengaging chamber 40 where vapor velocity is reduced to 0.5 ft./sec., thus settling out most of the catalyst, and thence withdrawn overhead into fractionator 42 to separate a toluene fraction, which may be solvent treated, finished and stored.

Spent catalyst is withdrawn from the bottom of reactor 35 and mixed with air from line 52 in mixer 50 and passed into regenerator 60 in the fluidized state, and the regenerated catalyst is removed by conveyor 100 and returned to storage hopper 1 for reuse.

Regeneration of Spent Caustic

IN THE WELL KNOWN method of regenerating caustic soda used for extracting mercaptans from gasoline, the spent soda is blown with air in presence of a catalyst (tannic acid) converting the mercaptans to disulfides which float on the surface and which may be removed readily. Such processes have been discussed in the literature.(1)

In its U. S. Patent 2,369,771, issued three years ago, Pure Oil Co. covered this type of regeneration in presence of an aromatic compound containing only three hydroxyl groups, all of which are attached to a single benzene ring in positions immediately adjacent to each other. Tannic acid possesses the formula:



Although it does contain three hydroxyl groups attached to a single benzene ring, in positions adjacent to each other, it will be observed that the compound has more than three hydroxyl groups. Hence, the patent does not cover tannic acid, and, as far as is known, there is no issued patent covering it.

However, the material is apparently expensive and searches are in progress to find cheaper substitute oxidation catalysts.

One recent patent issued to Pure Oil Co. covers certain hydroxy aromatic compounds such as 2,5 and 3,4 dihydroxy diphenyls as oxidation accelerators for this purpose.

References

(1) Birch & Norris, *J. Soc. Chem. Ind.*, 1925, p. 898. O'Donnell, *Oil & Gas J.* 7/1/44. LaCroix, *Oil & Gas J.* 2/10/44. U.S. 2,373,004 (Pure Oil). U.S. 2,237,467 (Stand. Oil Dev.). U.S. 2,263,043 (Tide Water Assoc. Oil).

Other Recent Patents

Below are presented brief reviews of other process and product patents recently issued and of interest to petroleum processors.

Process for solvent extraction with acetone of butanes and butenes from a mixture containing these and higher boiling hydrocarbons. U.S. 2,449,-610; John D. Long to Standard Oil Development Co.

Improvement in process for making solid polymer dispersed in liquid which comprises a continuous screening immediately after the reaction. U.S. 2,450,547 to Peter J. Gaylor.

Sulfonation of alkyl aromatic hydrocarbons, separating preferentially water-soluble alkyl aromatic sulfonic acids and further sulfonating the residue to produce preferentially oil-soluble alkyl aromatic sulfonic acids. U.S. 2,450,585; Edmond L. d'Ouville and Donald E. Burney to Standard Oil Co. (Indiana).

Continuous process for producing hydrogen by contacting steam with a fluidized mass of a solid metalliferous reducing agent. U.S. 2,449,-635; Frank T. Barr to Standard Catalytic Co.

Isomerization of normal butane to isobutane which includes passing the resulting stream from the hydrogen chloride-anhydrous aluminum chloride reaction through a bed of activated charcoal to produce further amounts of isobutane. U.S. 2,450,764; Charles O. Meyers to Phillips Petroleum Co.

Process for separating aromatics from a hydrocarbon mixture in the boiling range of gasoline and kerosine, by liquid cyclic adsorbing, using activated carbon. U.S. 2,449,402; Moses Robert Lipkin and Alfred E. Hirschler to Sun Oil Co.

Improvement for suppressing foaming in furfural solvent extraction by adding beeswax in amount in excess of its solubility in the furfural. U.S. 2,449,427. George Thodos and Charles F. Weinaug, to Phillips Petroleum Co.

Process for distilling oil from shale by continuous cycle method, using two or more reaction vessels, by feeding fine raw shale into fluidized mass of spent shale with a heat content effective for the distillation. U.S. 2,449,615; Edward B. Peck to Standard Oil Development Co.

Synthesis of hydrocarbons from hydrogen and carbon monoxide, in a series of reaction zones of ascending temperatures, with catalysts selected from cobalt, cobalt-thoria, nickel-thoria and iron group. U.S. 2,450,-500; Alfred Clark to Phillips Petroleum Co.

Desulfurizing a non-viscous, aromatic hydrocarbon oil with a solvent of liquid anhydrous HF, the raffinate phase comprising the aromatic constituents substantially free from sulfur. U.S. 2,450,588; Bernard L. Evering, Arthur P. Lien and James M. Page, Jr., to Standard Oil Co. (Indiana).

Valve lubricant for use in HCL or HF service consisting of a chlorinated paraffin wax and a thickening agent of graphite and asbestos. U.S. 2,-449,689; Paul H. Carnell to Phillips Petroleum Co.

In HF alkylation, azeotropic extraction of free HF from the effluent; fractionation, defluorination, dehydration steps for separation of fluorine-free higher boiling material, which is rerun to secure fraction in the motor fuel boiling range. U.S. 2,450,038; Frederick E. Frey to Phillips Petroleum Co.

Isomerization by contacting butene-1 vapor and anhydrous HF to effect conversion of butene-1 to butene-2 in the absence of polymerization and without substantial change in the carbon skeleton of the butene-1 molecule. U.S. 2,450,039; Frederick E. Frey to Phillips Petroleum Co.

Lube oil oxidation inhibitor comprising a phosphorus- and sulfur-containing reaction product obtained by reacting an alkyl halide and a phosphorus sulfide in the presence of a Friedel-Crafts catalyst. U.S. 2,449,-933; John J. Giammaria to Socony-Vacuum Oil Co., Inc.

Lube oil stability improver consisting of a reaction product of phosphorous pentasulfide. U.S. 2,450,405; Henry G. Berger, Thomas T. Noland and Everett W. Fuller to Socony-Vacuum Oil Co., Inc.

Foam-inhibiting additive consisting of a liquid non-volatile polymer of a chloro-fluoro substituted olefin of 2 to 10 carbon atoms. U.S. 2,449,631; John C. Zimmer and Raphael Rosen to Standard Oil Development Co.

Catalytic contact process in which the fluid reactants are introduced into lower portion of vessel containing solid catalyst slurry with sufficient force to cause turbulence of the slur-

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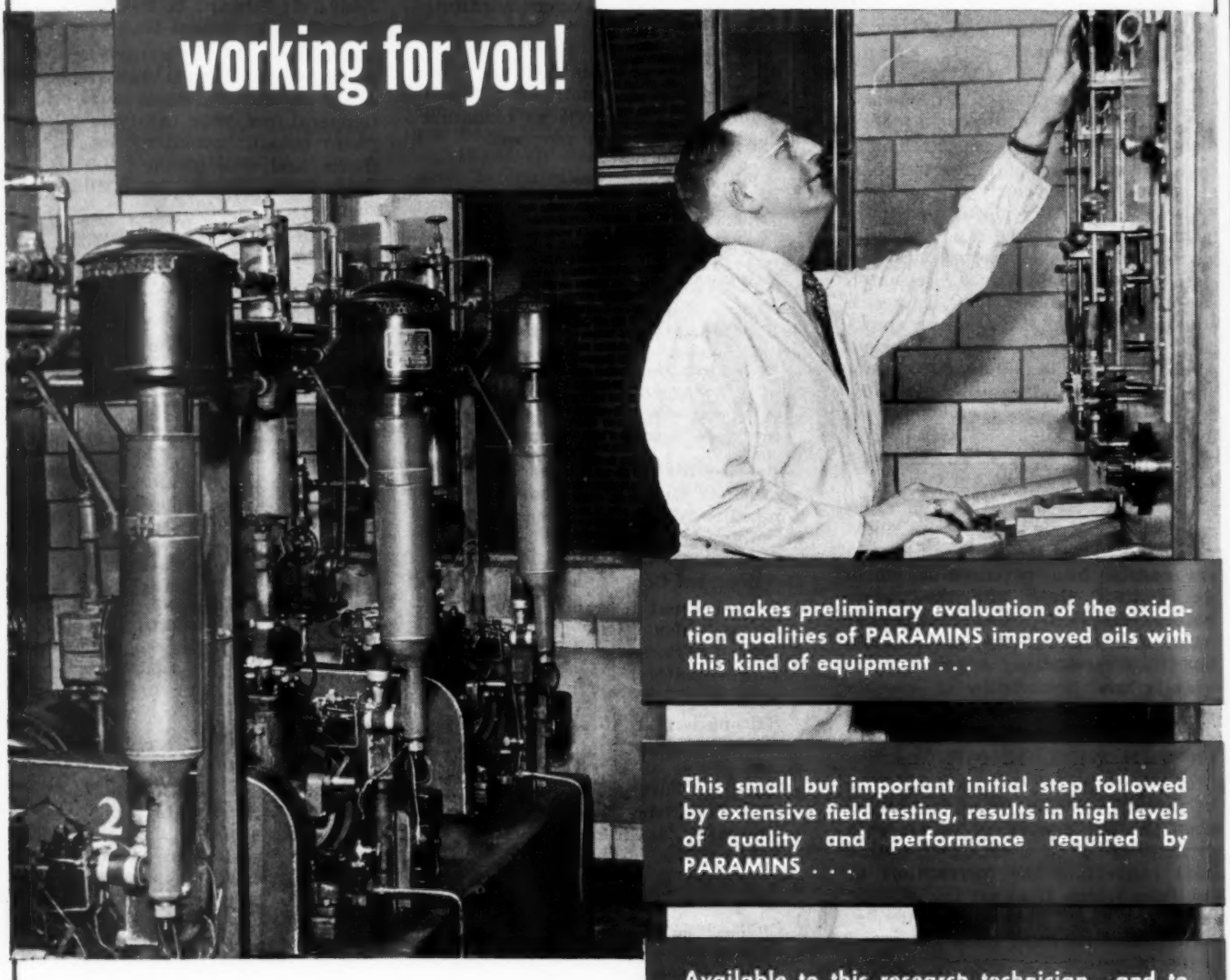

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ry; after settling of the slurry reaction products are withdrawn from upper part of vessel. U.S. 2,450,174; William W. Weinrich, Clark A. Holloway, Jr. and William S. Bonnell, to Gulf Research & Development Co.

Catalytic cracking process comprising bringing the heavy fraction of hydrocarbons and spent catalyst from the reaction into contact with a heated inert gas in a stripping zone, to strip the residual hydrocarbons from said heavy fraction. U.S. 2,449,617; Nick P. Peet to Standard Oil Development Co.

Synthesis of hydrocarbons by contacting synthesis gas containing essentially carbon oxide and hydrogen with a catalyst mass containing a metal of the iron group with a minor proportion on tellurium alloyed therewith. U.S. 2,449,775; Wealtha Eloise Hendriksen to Hydrocarbon Research, Inc.

Solvent extraction of unsaturated hydrocarbons by contacting a hydrocarbon mixture with a solution of a silver salt of a sulfonated aromatic compound in phenol and material from the group consisting of water and ethylene glycol. U.S. 2,449,793; Mott Souders, Jr. and Frederic A. French to Shell Development Co.

Multiple-stage regeneration of spent catalyst by passing through a series of regeneration vessels with successively lower pressures and higher temperatures. U.S. 2,449,622; Bruno E. Roetheli to Standard Oil Development Co.

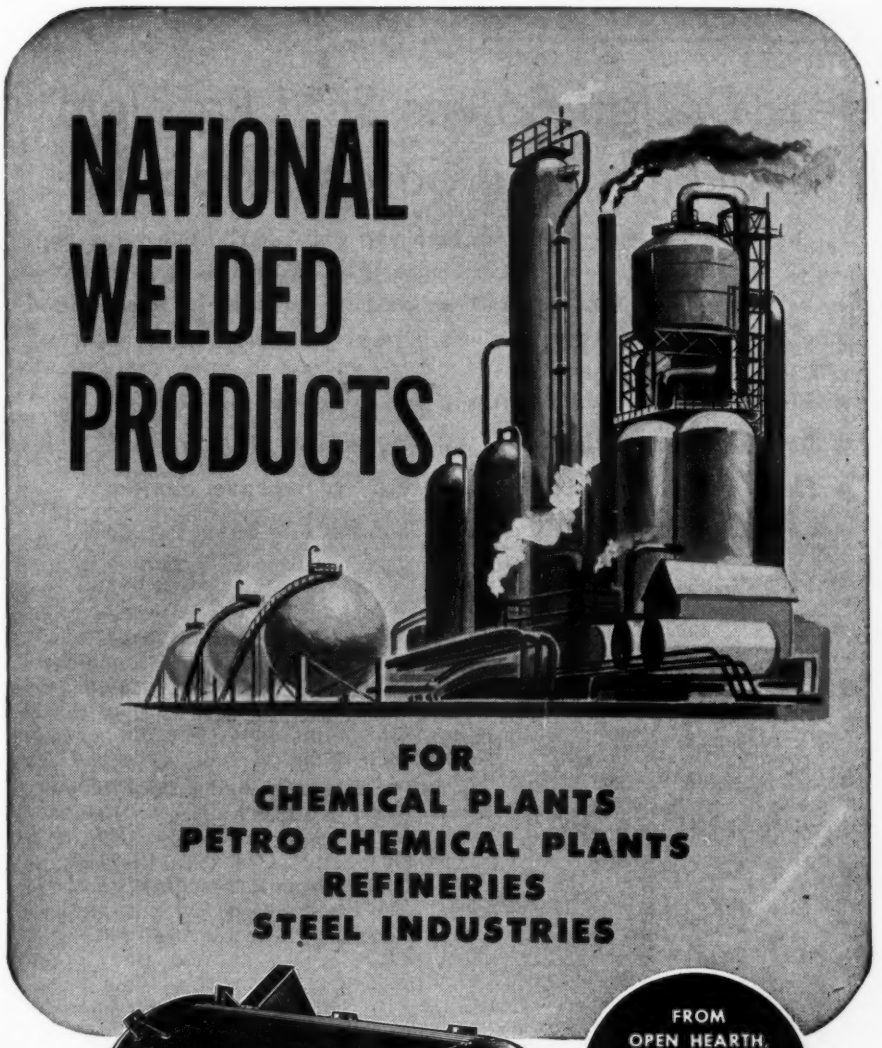
Combination desulfurization-cracking process by supplying solid cracking catalyst and sulfur-containing hydrocarbon first to desulfurization zone, then to cracking zone, withdrawing catalyst from latter for regeneration. U.S. 2,450,724; Henry W. Grote to Universal Oil Products Co.

Process for blown asphalts comprising air-blowing a high molecular weight hydrocarbon in the presence of a phosphorus catalyst stable at the required temperature. U.S. 2,450,756; Arnold John Hoiberg to Lion Oil Co.

Suppressing corrosion in ferrous alloy vessel by maintaining carboxylic acid vapor in hydrocarbon feed stock during a high-temperature, non-catalytic reaction. U.S. 2,449,585; Elza Q. Camp to Standard Oil Development Co.

Vacuum filtration of solidifiable substances from fatty oils in the presence of a solvent liquid by means of a rotating drum filter. U.S. 2,450,235; William P. Gee to The Texaco Development Corp.

Hydrogenation catalyst consisting of an HF acid-treated bentonitic clay impregnated with metallic nickel. U.S. 2,450,316-17; Alexis Voorhies, Jr. and William E. Spicer to Standard Oil Development Co.



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New Design Solves Seal Problem In Cracking Unit Surge Hopper

In addition to the method for obtaining a gas-seal in the surge hopper of a moving bed catalytic cracking unit described below, this month's review of new and improved devices used in petroleum processing and handling operations on which patents have been issued recently includes:

- **Reduce rotary pump friction by using needle rollers**
- **Dual-purpose fitting suits two types of pipe joints**
- **Flask heater uses convection heat to improve control**
- **Combination tower economic in lube oil manufacture**

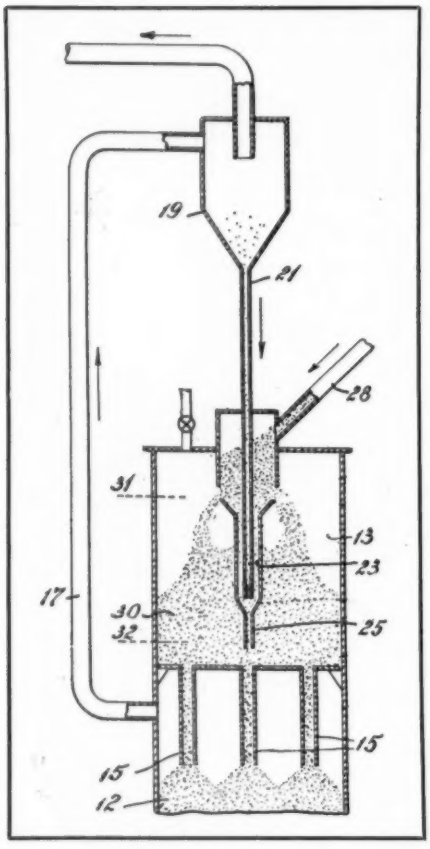


Fig. 1—Solid catalyst flow in space 23 and pipe 25 form an effective gas seal in moving bed catalytic cracker (U.S. 2,451,924)

WIDE AND RAPID fluctuations in the catalyst level in the surge hopper above the regenerator constitute a frequent and troublesome problem in the operation of moving bed catalytic cracking units because an effective gas seal cannot be maintained. One method for eliminating this problem is shown in Fig. 1.

In operation, entrained catalyst particles are removed from the flue gas in separator 19 and pass down through line 21 and line 25 into the bed 30 of solid material in surge hopper 31, directly above the center drain pipe 15, whence they join other solid material and enter the regenerator 12. The main catalyst charge enters via feed pipe 28 and is directed downward over the upper end of annular space 23, keeping it filled with solid material. The overflow drops to the surface of bed 30.

It has been found that by proper positioning of the inlet to pipe 25 directly below the center of the discharge end of pipe 21, the solid material from pipe 21 will flow into pipe 25 in preference to the material from space 23. The column of solid material in space 23 and that passing through pipe 25 and extending below the end of pipe 21 serve as constantly maintained gas seals between separator 19 and surge chamber 13.

U. S. 2,451,924, issued Oct. 19, 1948, to John A. Crowley, Jr., assignor to Socony-Vacuum Oil Co., Inc.

Rotary Pump Friction Reduced By Series of Needle Rollers

FRICTION BETWEEN rotors and housing in rotary piston pumps for handling abrasive slurries and the like is a frequent cause of rapid wear which can be minimized considerably by employing a form of rolling contact in the pump design. The improved design is explained in the drawing in Fig. 2.

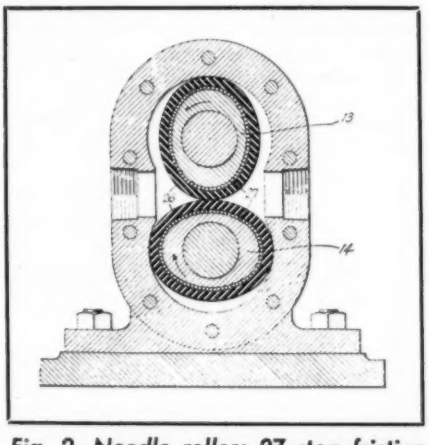


Fig. 2—Needle rollers 27 stop friction in rotary pump (U.S. 2,451,603)

Pump 1 comprises simply two intermeshing conjugate rotors 13 and 14. Conventional protection for the rotors against abrasion is provided by flexible bands 26, made of natural or synthetic rubber, plastic, or other material depending upon the nature of the fluid being pumped.

Normally bands 26, being secured tightly to the rotors, would wear rapidly. In this invention, however, they have been separated from the rotor surface by a series of small diameter needle rollers 27, constituting a means for reducing the friction.

U. S. 2,451,603, issued Oct. 19, 1948, to Virgil D. Barker, Westfield, N. J.

Combination Tower Is Economic In Lubricating Oil Manufacture

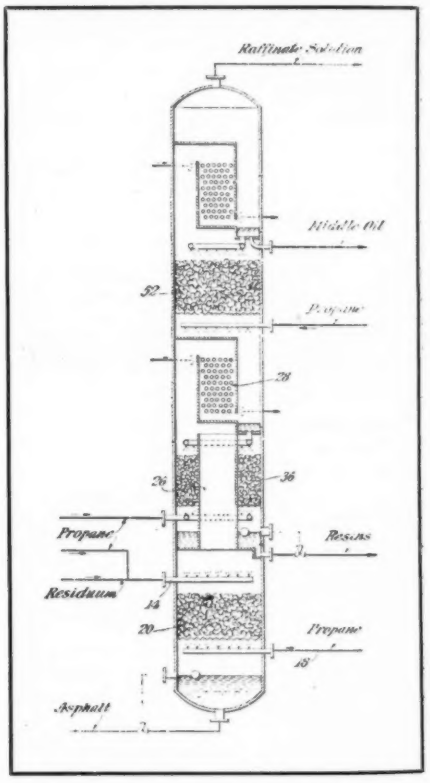


Fig. 3—Distillation and extraction both take place in same lube oil tower (U.S. 2,451,433)

REDUCED EQUIPMENT cost, decreased product losses, and improved product are claimed as advantages in a single extraction tower which combines both distillation and propane extraction of topped residuum in the same vessel to produce lube oil, resins and asphalt. The unit is illustrated in Fig. 3.

Gas oil-free residual stock enters at 14, together with a sufficient quantity of propane to reduce its viscosity. Asphalt which precipitates at this point is washed counter-currently by propane introduced at 18 be-

low section 20, packed with Raschig rings or similar packing.

The solution of propane-deasphalted oil passes up through flue 26 and around a baffle arrangement and heater coils 28 where, because of close temperature control, the resins are precipitated out after dropping through another propane wash section 36. This same operation repeats at the next level above for the middle oil cut and the raffinate overhead.

U. S. 2,451,433, issued Oct. 12, 1948, to Hyman R. Davis, assignor to The Lummus Co., New York City.

Flask Heater Uses Convection, Improves Temperature Control

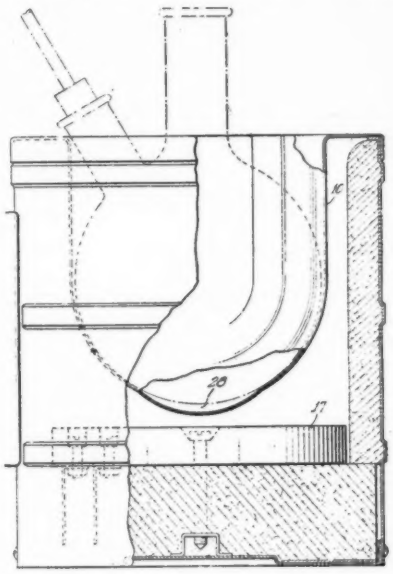


Fig. 4—Lack of heat conduction in flask heater permits even temperature control (U.S. 2,450,981)

CLOSE TEMPERATURE control with no superheating of the flask contents can be obtained in an electric flask heater in which the bowl is surrounded by an air space, thus heating partially by air convection. The design is shown in Fig. 4.

Element 17 is circular and flat, rather than following the contour of the flask-holding bowl 10. Residual heat both in the element and in the heater interior does not elevate appreciably the temperature of the flask contents after the current is turned off, because little heat can be transmitted by conduction, and the convection air holds little heat (having very low specific heat). Radiant heat transmission also stops.

Superheating is avoided because it is difficult to transmit heat by convection directly to the vapor, the vapor being heated almost entirely by the liquid. The shape of the bowl provides an extra air space 28 between the bottom of the flask and the bottom of the bowl, which helps to prevent "bumping" from hot spots.

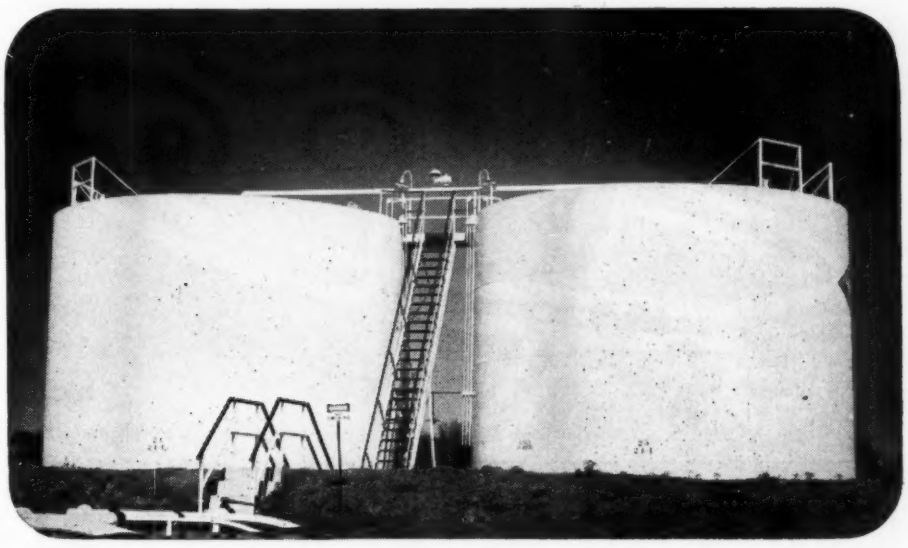
U. S. 2,450,981, issued Oct. 12, 1948, to A. I. Newman, assignor to Precision Scientific Co., Chicago.

Dual Purpose Fitting Suitable For Two Types of Pipe Joints

PIPE END MEMBERS which include both a groove and a thin butt-end will permit normally thin-walled pipe on which they are used to be connected by either conventional butt-welding or a clamp arrangement of the so-called "victaulic" type.

Partial cross sections of two pipe end fittings of the same design being used for each kind of joint are illustrated in Fig. 5. The fittings 6 are welded at point 7 to each pipe 5. In the upper view, the weld 12 can be made satisfactorily because of the relatively thin sections 9a, corresponding in effect to a typical bevel end. Necessary strength and spacing is provided by ring 10 in the channel formed by recesses 9.

In the lower view, the split ring



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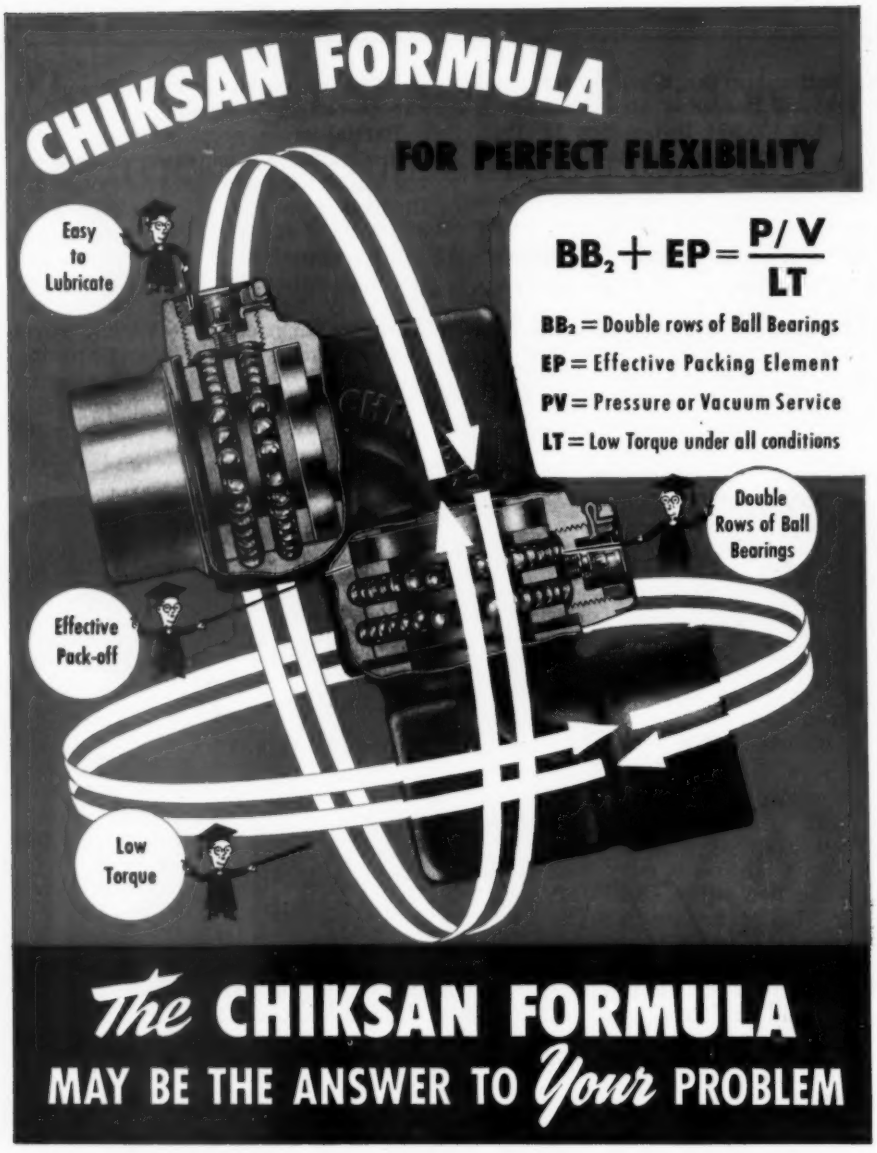
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clamp 13 is in place with its legs in grooves 8, and containing the hollow, rubber sealing ring 14 which comprises the victaulic joint. Ring 10 again is used to maintain proper spacing and a fluid tight seal.

U. S. 2,451,587, issued Oct. 19, 1948, to Edward H. Taylor, assignor to Taylor Forge & Pipe Works, Cicero, Ill.

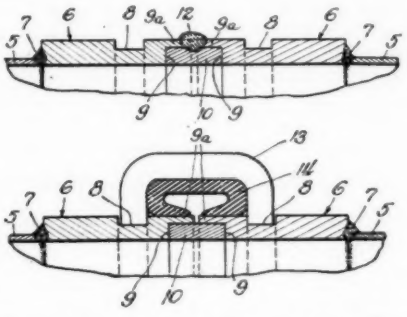

Fig. 5—Above, butt weld; below, clamp type joint, both using same pipe end fitting (U.S. 2,451,587)

Other Recent Patents

Space does not permit the complete review of all patents issued recently on equipment for the petroleum processing industry. Following, however, are brief abstracts of those with greatest interest:

Continuous Specific Gravity recorder for hydrocarbons under actual conditions during processing which uses two floats, comparing the effects on each by the process fluid and a standard fluid. U. S. 2,451,036, issued Oct. 12, 1948, to J. R. Martin and F. B. Burrell, assignors to Standard Oil Development Co., Baytown, Texas.

Vacuum Storage Tank for storing liquefied hydrocarbon gases at temperatures as low as 260° F., where the weight of the liquid is carried by a thin inner metal membrane not susceptible to heat or cold, such as nickel or Monel, and supported on insulating members connected to ordinary carbon steel outer shell, the annular space being evacuated. U. S. 2,451,486, issued Oct. 19, 1948, to George T. Horton, assignor to Chicago Bridge & Iron Co., Chicago.

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EQUIPMENT
MATERIALS
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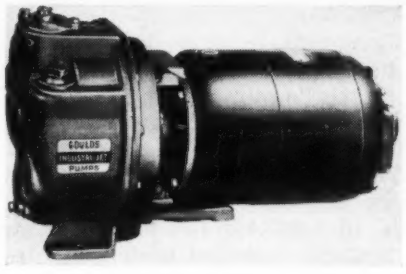
LITERATURE

What's New!

Reviewed by WILLIAM C. UHL, Equipment Editor

1—Jet and Centrifugal Combined

Combination of a centrifugal pump with a jet or ejector in one unit is provided in the "Industri-Jet" Pump, which is said to be an economical, long life pump for relatively small capacities against high pressures. It is built in sizes ¼ to 5 hp., capacities up to 35 gpm., for pressures up to 190 psi., depending upon capacity. The pump is suitable for handling cold or hot water, kerosene, gasoline, alcohol, carbon tetrachloride and similar liquids in such industrial applications as general water circulating service, condensate return, boiler feed, filter press service, and the like. Goulds Pumps, Inc.

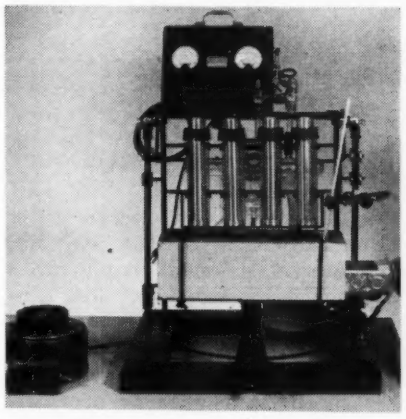


2—Paint Withstands 1500 F

"Heatrem," a new high-heat resisting aluminum paint, is made specifically for use on exterior or interior metal surfaces where temperatures reach 1500° F., or for any wood, brick, or concrete surfaces exposed to extreme heat conditions, according to the manufacturer. The material is claimed to fuse with the metal surface to form a finish which is resistant to moisture, corrosion, acids, alkalis, and fumes. It will set up in four hours and dry completely overnight. Speco, Inc.

3—Still for Semi-Micro Analysis

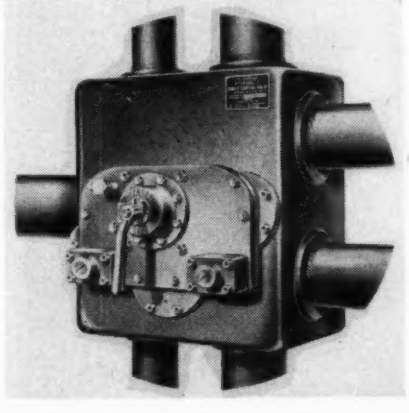
Molecular distillation for semi-micro analyses may be carried out on several samples simultaneously in a



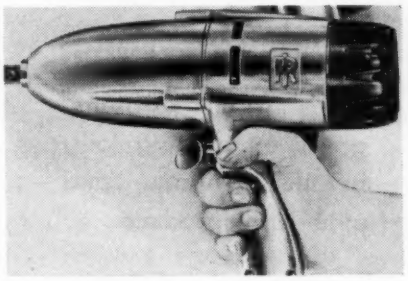
new still now available for prompt shipment. Operating under high vacuum to pressures as low as 1 x 10^{-5} mm. of mercury, the stills are used to separate heat-sensitive substances of high molecular weight. Samples are loaded into each unit, which is then immersed in an oil bath with temperatures controlled through an electrical resistor. Distillate collects on the condenser, which is removed to obtain the fraction after each distillation. Samples may range from a few milligrams to a gram in each still unit. Distillation Products, Inc.

4—Six-way Valve for Water Treaters

The Cochrane "Hydromatic" Single Control Valve, standard equipment now on the Cochrane line of zeolite water softeners and pressure filters,



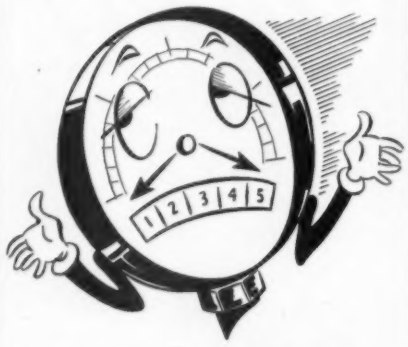
is said to reduce the time required by the plant operator, and minimize faulty operation through error in manipulation. It is a six-position valve, with four normal operating and two standby positions. In zeolite systems, the four positions provide separate control of backwash, regenerant feed, rinse, and service. In pressure filters, only three positions are essential in most cases; backwash, rinse, and service. The fourth position permits actuating such devices as a filter agitator or a filter aid or pre-coat type of chemical feed. The valve is pilot-actuated, power for operation of the valve members being provided by the raw water itself, resulting in smooth operation. It is available also for use in demineralizing systems or for ion exchange systems in process applications. Cochrane Corp.



5—Large Impact Nut Setter

Model "8U" is a new larger and heavier electric impact tool of the same general design as the previously-announced Model 4U. With standard accessories, it will run and remove nuts up to ⅝-in. thread size; drive and remove studs; extract broken cap screws and studs; apply and remove machine screws of all kinds; run wire brushes; drill brick, metal, and masonry; tap; and ream. It is 12⅛ in. long, and weighs 9 lbs., 13 oz., and is available for either 110 or 220 v., AC or DC operation. Ingersoll-Rand Co.

More "What's New!" Items, p. 1226



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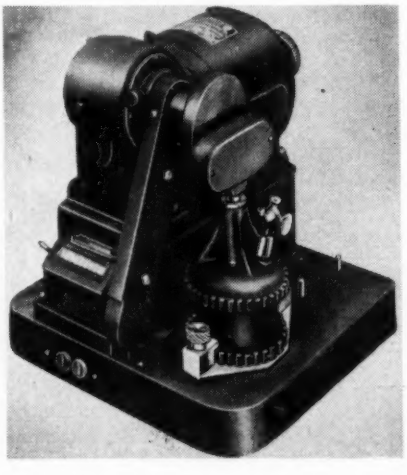
6—Bubbler Type Purge Meter

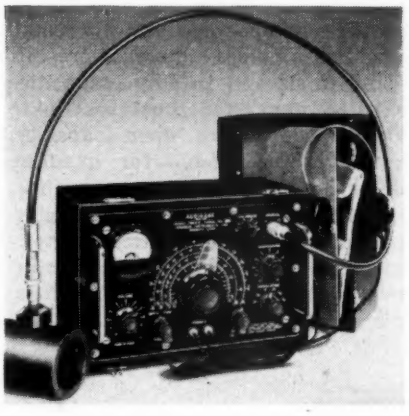
The "Bubbler Type" purge meter is an adaptation of the standard "Flowrator" instrument that includes a built-in needle valve for close control of purge rates. It is designed for measurement of gas or liquid purge rates in familiar flow units, cu. ft./hr. of air, or gals./hr. of water, and covers the ranges generally accepted as standard for bubbler installations. The unit consists of a Pyrex or stainless steel ball-shaped float, a precision-bore Pyrex metering tube, and a die-cast body. Fischer & Porter Co.

7—Motor-driven Grease Worker

The "Motor-Matic" grease working machine is a labor-saver when running penetration tests in which the grease must be worked with 100,000 strokes before the test; for example, in the Army-Navy test AN-G-15-a. Featuring interchangeable plunger plates, the grease worker conforms to both the Army-Navy test, which prescribes 270 1/16-in. holes, or the ASTM-D217 specifications, which prescribe 51 ¼-in. holes. The plunger is operated by a ¼-hp. electric motor with a gear reducer that drives the crank at approximately 60 strokes/min., as required by ASTM. A counter turns the machine off automatically at the end of the proper number of strokes. The motor is fully-enclosed, with sealed lubrication. The Motor-Matic machine comes in a single unit, or a dual unit which meets the needs of laboratories making a large number of tests. Precision Scientific Co.



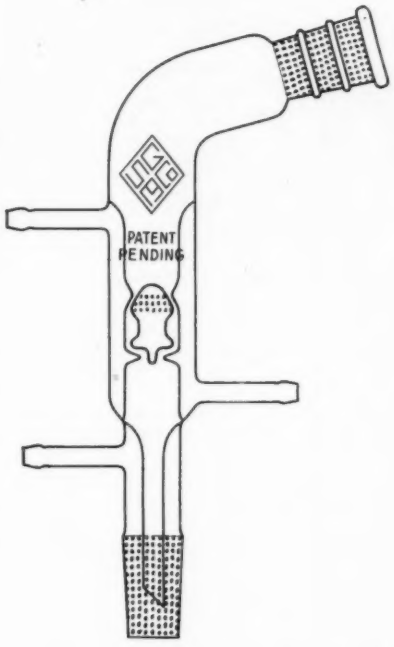
8—Improved Thickness Gage



Model FMSS-5 is an improved model of the "Audigage" Thickness Detector which is said to contain the following new features: instrument indications, for use in noisy locations; adjustable frequency modulation, to facilitate the measurement of seriously corroded equipment; increased frequency range, for measurement of steel down to 1/16 in.; special permeability tuning unit for increased sensitivity over the whole frequency range. The instrument is used for non-destructive thickness measurement of steel, copper, aluminum, glass, unfilled plastics, and other materials, from one side; for example, tanks, pipes, boilers, pressure vessels, and the like. It is portable and battery operated, for field use. (See also "What's New!" October, 1947, p. 785, Item 2.) Branson Instruments, Inc.

9—Glass Vacuum Still Adapter

The Theimer Vacuum Adapter for fractional vacuum distillation removes the required cuts without disturbing the vacuum within the still, and eliminates the manipulation of a number of glass stopcocks. It em-

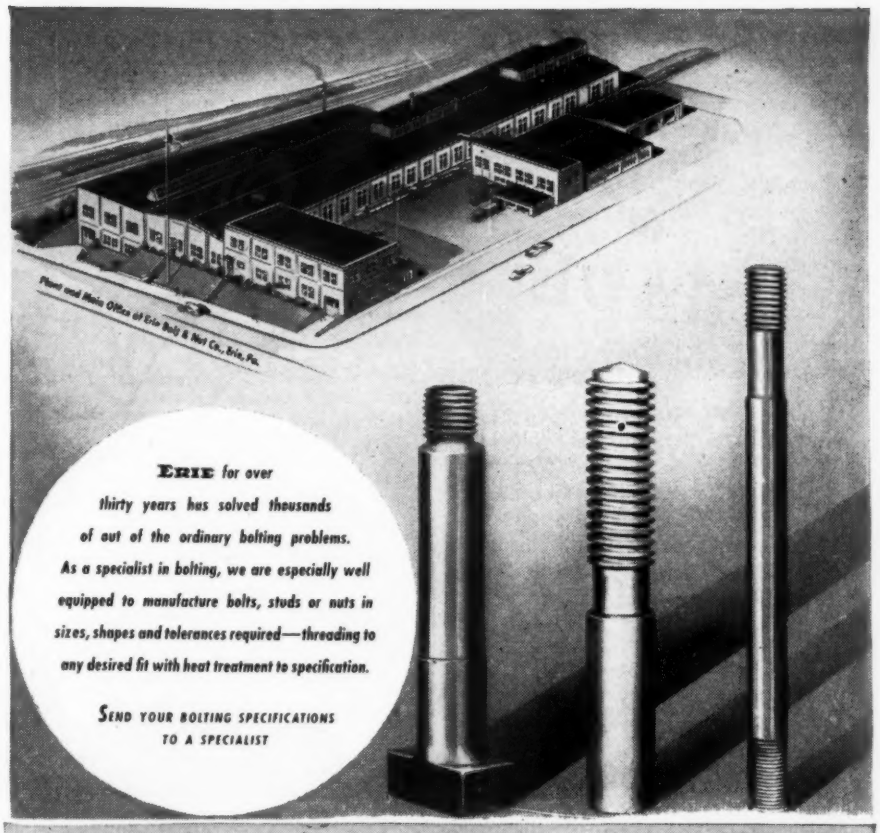


ploys an internal glass valve which is automatically lubricated by the distilling liquid. All manipulation is in a three-way stopcock in the pump system, removed from contact with the distillate. In operation, the system is evacuated through the adapter and the stopcock. When the receiver is to be removed, the stopcock is turned 90° to admit air into the receiver. The inrushing air automatically closes the valve so that no air gets into the rest of the system. The distillation continues smoothly although the source of vacuum is temporarily cut off. When the emptied receiver is replaced, the stopcock is returned to its orginal position. As soon as the receiver is evacuated to the same pressure as the rest of the system, the valve falls into the open position. The Theimer unit is available in two models; with or without a cooling jacket around the valve, and in a variety of sizes of standard taper or semi-ball connections. Scientific Glass Apparatus Co., Inc.

10—Waterless Hand Cleanser

With lanolin as one of the essential ingredients, "Little Doc Disolvit" is a new waterless cleanser which is said to remove grease, dirt, paint, rubber cement, tar, asphalt, and similar substances from the hands without irritating the skin. Free from skin-drying ammonia, it prevents chapping. The material is available in pints, quarts, gallons, and five-gallons. Schaffner Industries, Inc.

More "What's New!" Items, p. 1229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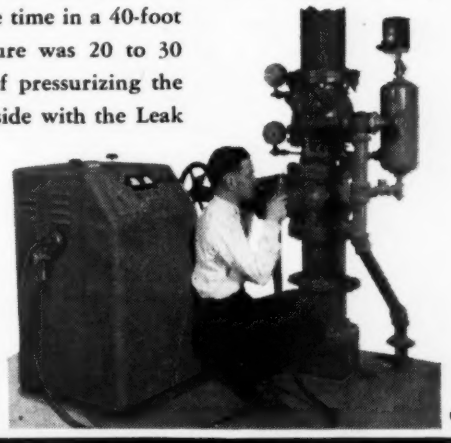

For additional information on application and technical information on the Consolidated Leak Detector write for the informative bulletin CEC-1801-X7

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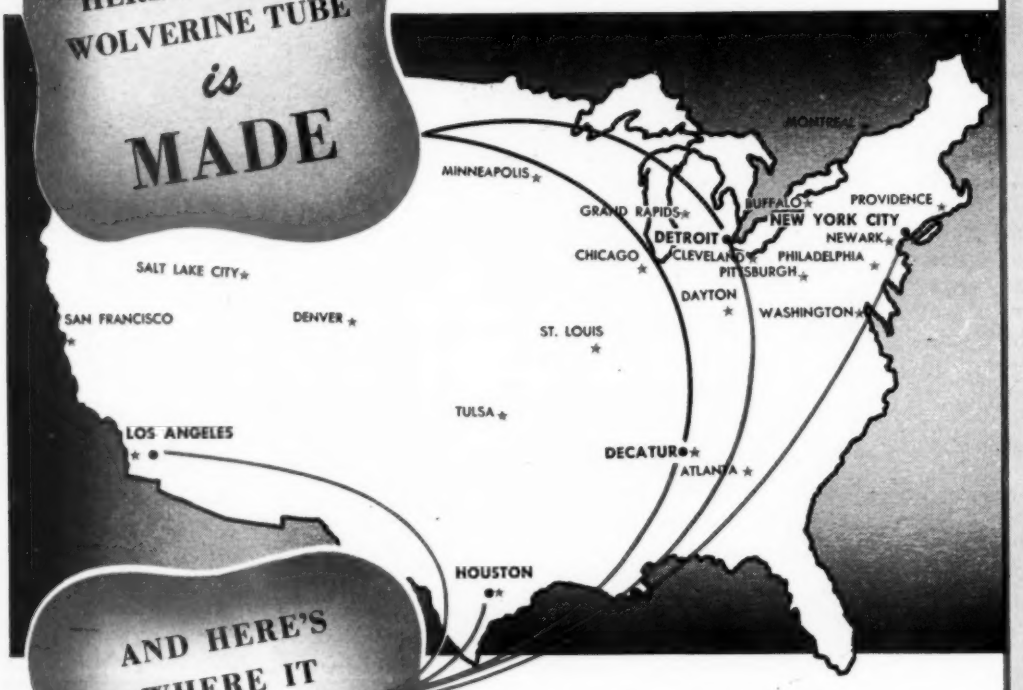

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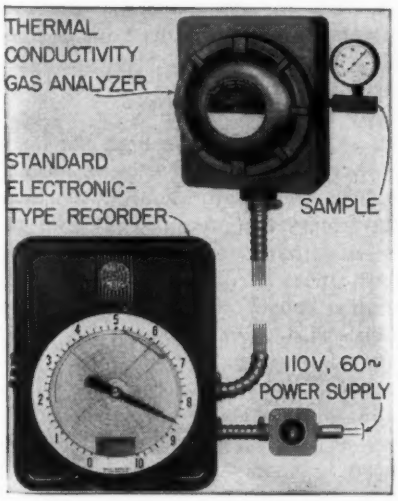
11—Conductivity Gas Analyzer



The Bailey Thermal-conductivity Type Gas Analyzer works on the standard principle of thermal conductivity gas analysis which measures the rate at which heat is conducted by the gas being sampled. It is mounted in an explosion-proof case and is unaffected by voltage variations, ambient temperature, and variations in sample pressure. An all AC circuit is employed, permitting the use of a standard Bailey Electronic Recorder, which does not require dry batteries or a standard cell. The recorder uses electron tubes instead of a galvanometer. Two records of thermal conductivity can be placed on the same 12-in. chart, or one record may be combined with flow, pressure, temperature or some other related factor. Bailey Meter Co.

12—Medium Pressure Reactor

The Parr Medium-pressure hydrogenation apparatus is designed for hydrogenation or other reactions between liquids and gases at up to 1000 psi. and 350° C. It consists of a stainless steel reaction bomb, a heater, and an electric-motor driven stirrer, assembled on a steel base plate. Units are made with either 1000 ml. bomb, Model No. 23006; or 2000 ml. bomb, Model No. 23005. Cylinder and cover of the bomb are machined from solid forged bars of Type 316 stabilized stainless steel, and are sealed by a Silicone gasket recessed in the cover. A split-ring type of closure permits the unit to be opened or closed without disturbing the cover fittings. Safety blow-out fitting will burst at about 1800 psi. Electric heater is manually controlled and provides for maximum input of 1500 watts for rapid heating. Stirrer drive motor is 1/15 hp., 1725 rpm., constant-speed, and is arranged to drive stirrer at approximately 600 rpm. Central Scientific Co.

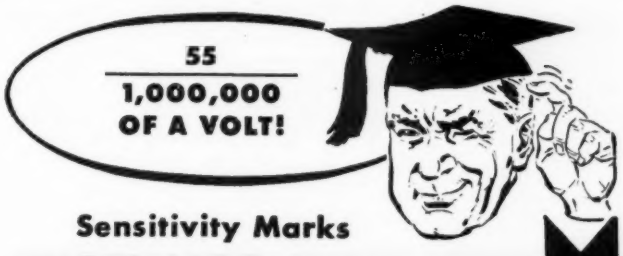
13—Safe Flexible Metal Hose

The "Penflex" line of flexible metal hose is now offered in all standard sizes in a new safety-style for use with flammable liquids. It is a copper-clad steel hose of full interlocked construction and asbestos packed. The copper coating will not peel or cannot be pulled off, the manufacturer states. Fitted with brass couplings the hose is supplied in various standard I.D.'s up to 12 in. Pennsylvania Flexible Metal Tubing Co.

14—Resistance Bulb

The "Dynatherm" Resistance Bulb can now be supplied with any Dynalog instrument, or the new Multi-Record model. It is a standard product suitable for installations for operating temperatures below 600° F. It can replace any thermocouple or filled-system bulb, in a well of ¼-in. diameter or more and of any depth or any material. Its adaptability results from the fact that heat transfer to the sensitive portion is through the tip instead of the sidewalls. It is therefore easily brought into actual contact by pushing it against the end of the wall, thus contributing to precise and rapid temperature measurement. Foxboro Co.

More "What's New!" Items, p. 1230



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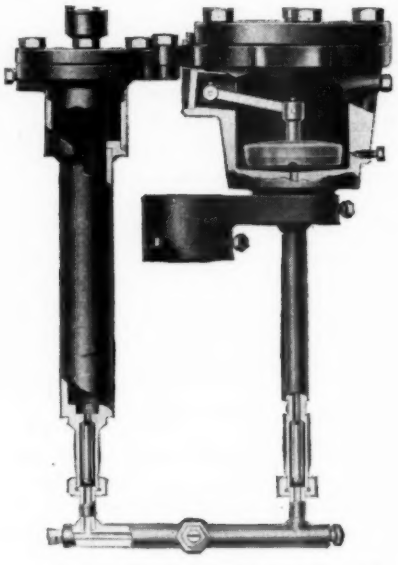
What's New!

15—Titanium Now Available

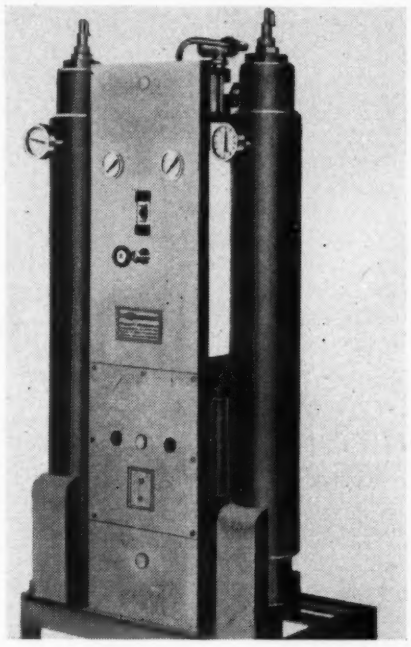
Titanium metal, a new basic raw material for industrial research is now being manufactured on a small scale in a pilot unit of 100 lbs. daily capacity. The material is one with many as yet unknown potential uses. Its properties include high strength-to-weight ratio, corrosion-resistance, high melting point, ductility, and relative abundance in nature, being the seventh most common metal and ninth most common element in the earth's crust. It is comparable to stainless steel in strength and corrosion resistance, but is a little over half the density of stainless. Most titanium available up to now has been in powder form. It is to be produced in sponge form and will soon be available in ingots weighing up to 100 lbs. Present price in sponge form is $5 per lb. in quantities of 100 lbs. or more; ingot prices are to be set later. E. I. du Pont de Nemours & Co.

16—Manometer Has Wide Range



The new Model 1500 Taylor Mercury Manometer is said to overcome points usually criticized by users of conventional mercury manometers. A large diameter float and long float travel provide greater energy output. Overrange protection is obtained with positive acting, non-sticking check valves submerged in mercury. Interchangeable range chambers make the instrument adaptable for continuous ranges from 10 to 533 in. of water. and require no piping changes when shifting from one range to another. Straight-line calibration is an inherent feature of the instrument, which has a 1500 psi. working pressure. Taylor Instrument Cos.

17—Instrument Air Dryers



The Anders' line of Compressed Air Dehydrators are fully automatic, according to the manufacturer. The units are being made in nine standard models with capacities from 15 to 750 cfm. (STP), based on 100 psi. and 70° F. Operating pressures can vary from 30 to 150 psi., or 40 to 120° F., inlet temperatures, and final exit dew points as low as —60° F. All models can be furnished for either electric or steam operation, and are designed for ready conversion to either type. The Anders Co.

Trade Literature

18—Chlorine Technical Data

Chlorine, a 72-page technical data book giving charts, diagrams, and photographs on the production and handling of chlorine and several of its end-products, including complete data on the properties, preparation and analyses of several bleach liquors, as well as safety precautions, shipping, equipment, and construction materials information. Pittsburgh Plate Glass Co.

19—Steam Line Corrosion

Steam Line Corrosion Control; a four-page bulletin presenting data on a chemical method for the prevention of corrosion in steam and condensate lines and plant equipment. E. F. Drew & Co., Inc.

20—Petroleum Processing Index

Petroleum Processing Index for 1948; covers all special articles and stories as well as all regular departmental features for the 12 issues of the year. Classification by subject and by author, completely cross-referenced for ease of use. Available shortly after January 1, 1949. National Petroleum Publishing Co.

21—Hard Surfaces by Welding

Hard Facing or Hard Surfacing by Welding, Tempil Topics, Vol. 3, No. 11; a data sheet presenting instructions on the use of fusion welding of hard surfaces for repairing for example, valve seats, pump shafts, valve stems, and the like. The Tempil Corp.

22—Stainless & High Alloys

Stainless and High Alloy Steels in Process Equipment, Form 168; a 40-page catalog on a complete line of castings, heat exchangers, coolers, pipe, fittings, flanges, valves, and process specialties for petroleum and similar industries. Electric Steel Foundry Co.

23—Rust-preventive Oils

Action of Rust-Preventive Oils, a reprint of a paper under same title by E. R. Barnum, R. G. Larsen, and A. Wachter, of Shell Development Co., and presented at the annual meeting of the National Association of Corrosion Engineers, April, 1948, in St. Louis. Shell Development Co.

24—Chemistry of Furans

Furan Chemistry, a 40-page booklet presenting seven papers comprising a symposium on this subject and given at the 112th meeting of the American Chemical Society, including one on furfural as a selective solvent in petroleum refining. The Quaker Oats Co.

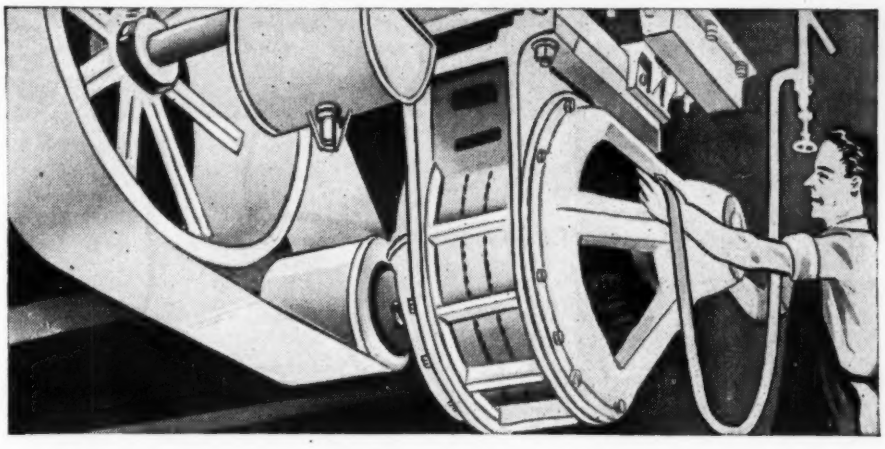
25—Cathodic Protection

Metallic Rectifiers, Bulletin B-3996; covers description of electrical equipment used for cathodic protection of underground structures against corrosion. Westinghouse Electric Corp.

26—Safety & Relief Valves

Farris Safety and Relief Valves, Catalog 48; 72 pages on complete line of safety and relief valves, including a 26-page section of design data, water, air, and steam capacity tables for various nozzle orifice sizes, and a new tight vapor sizing chart. Farris Engineering Corp.

More "What's New!" Items, p. 1233



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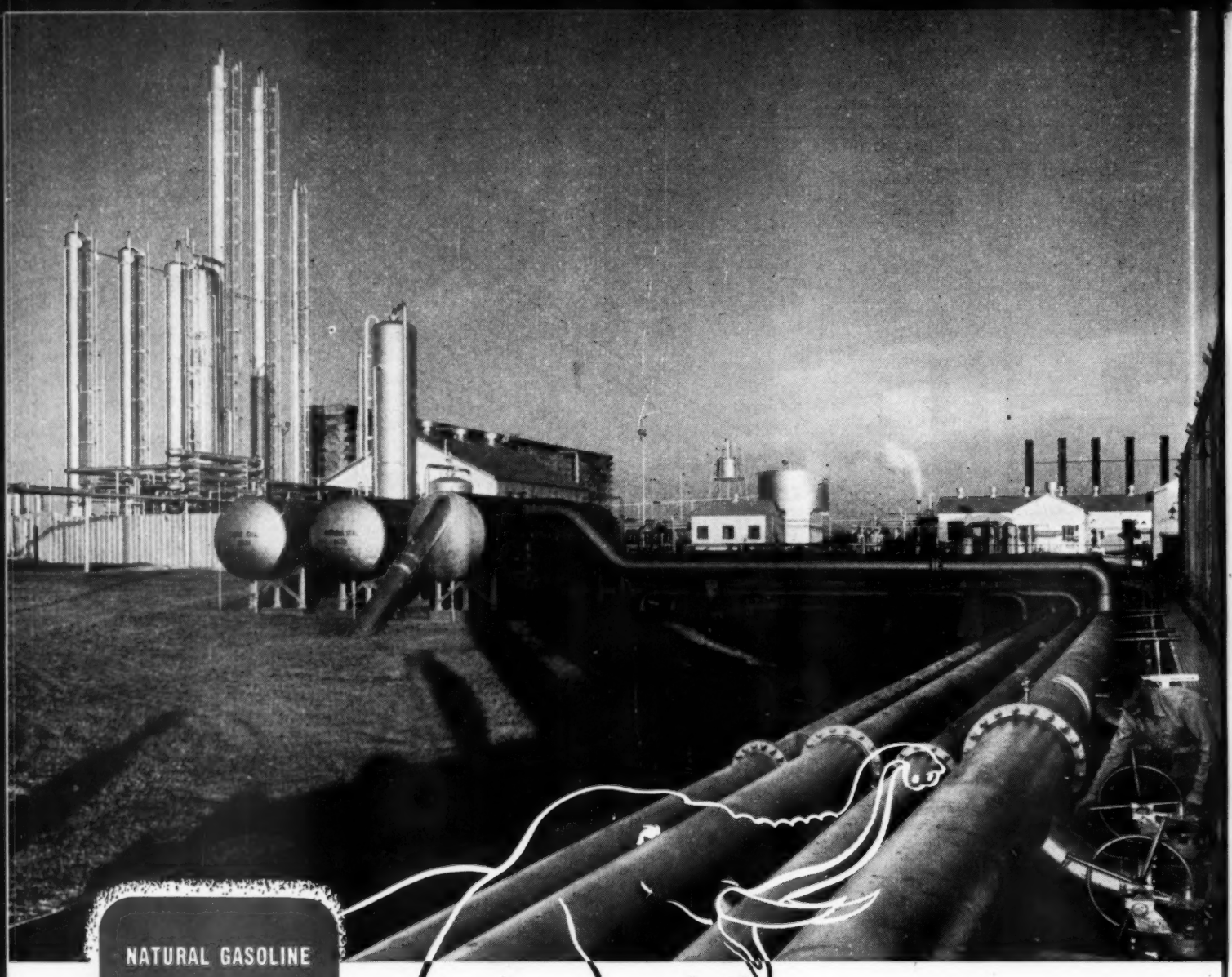

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27—Pressure & Vacuum Gages

Pressure and Vacuum Gauges, Catalog 7000; a 32-page booklet including schematic drawings, photographs, diagrams, range charts, and indicating scales on indicating, recording, and controlling instruments for pressure and vacuum. Brown Instrument Co.

28—Personnel Selection

The Kopas Method; a four-page bulletin describing a technique for testing and selecting the right worker for the right job; method being based on measuring applicant's various mental and physical qualities as well as his background, aptitudes, and interests. Management Personnel Corp.

29—Recording Instruments

Temperature and Pressure Recorders, Catalog 700; 12 pages describing and illustrating gas-filled recorders and recording pressure gages; details of bulb construction and pen arm movement presented in photographs and line drawings; tables give chart specifications. Penn Industrial Instrument Corp.

30—Electric Power Factor

Power Factor and What To Do About It, Bulletin No. 200-TEC-1077, a 20-page pocket size booklet explaining the essentials of power factor and giving a digest of power factor calculation, why low power factor should be corrected, and how it can be done. Electric Machinery Mfg. Co.

31—Welding Equipment

Victor Apparatus Catalog, Form 20B; a 40-page booklet giving colored working drawings, specifications, and photographs covering a line of gas welding equipment and accessories, including instructions on operating a cylinder manifold. Victor Equipment Co.

For Your Convenience

Business reply cards are included in this issue of PETROLEUM PROCESSING to assist you in obtaining more information on any items reviewed in "What's New!" You'll find them facing page 1225. Just circle the numbers corresponding to the numbers on the items you're interested in, fill in the bottom of the card, and drop it in the mail. No postage required.

32—Exhausters & Compressors

SK Steam Jet Exhausters and Compressors, Bulletin 4-E, describes with tables, charts, and colored diagrams a line of equipment for pump priming, exhausting, evacuating, cleaning, transporting, and agitating liquids and gases. Schutte and Koerting Co.

33—Pump and Heater Sets

Peabody Pump and Heater Sets, Bulletin 150; four-page folder describing duplex units for operation of oil-fired burners; each unit featuring duplicate equipment so as to eliminate the possibility of shutdowns. Peabody Engineering Corp.

34—Turbine-type Pumps

Roth Turbine-type Pumps, Bulletin 101; 18 pages covering heavy duty flexible coupled pumps, special metal pumps, and a series of industrial pumps, including catalog data, specifications, selection tables, and prices. Roy E. Roth Co.

35—Gas Analysis Apparatus

Burrell Industro Gas Analyzer, Bulletin No. 213, describes two new models of gas analysis apparatus, one of which is designed to handle hydrogen and methane as well as oxygen, carbon dioxide, and carbon monoxide. Burrell Technical Supply Co.

IMPROVED SARGENT

Cone Drive Stirring Motor

New Model, Now Available from Stock—

In redesigning the Sargent Cone Drive Stirring Motor, the basic form, size and characteristics, including the method of transmitting power by means of a driving cone and a driven ring have been retained because of definite advantages they have displayed over other types of stirring apparatus during many years of proven performance in the field. However, now, certain mechanical inconveniences in manipulation which formerly existed, have been eliminated and the efficiency and ease of operation greatly increased.

NEW MOTOR MOUNT—The motor is mounted on a threaded rod and urges the driving cone against the friction ring by means of a pressure plate with adjustable spring tension. This type of mounting permits the motor to be swung away and held in a free position without changing the lateral position of the chuck. For additional convenience, the motor may be swung to either side of the friction ring, from where it will operate with equal efficiency.

FULL POWER AT ALL SPEEDS—The patented Sargent cone-to-ring device in which the driving cone and the driven ring rotate in the same plane, reduces cross-drag to a negligible quantity and delivers full power to the chuck at all speeds from 75 to 1300 r.p.m.

CHUCK HELD IN FIXED POSITION—The speed is varied by turning a hand wheel which raises or lowers the motor and alters the position of the cone with relation to the friction ring. In this type of design the ring and chuck are held in a fixed position and all lateral movement is in the cone and motor.

FEED-THROUGH SPLIT-COLLET CHUCK—Another feature of the new model Sargent Cone Drive Stirring Motor is the feed-through split-collet chuck which permits the stirring rod to be removed from the vessel in which material is being stirred, without repositioning the motor on the support rod. To accomplish this, merely swing the motor to one side, loosen the chuck and raise the stirring rod out of the vessel through the open top of the chuck.

S-76445 STIRRING MOTOR, Electric, Sargent Cone Drive, Variable Speed, Patent No. 1,973,576. For operation from 115 volt 50/60 cycle A.C. circuits.....$45.00

S-76465 Ditto, but for operation from 230 volt 50/60 cycle A.C. circuits.....$55.00

SARGENT

SCIENTIFIC LABORATORY EQUIPMENT AND CHEMICALS

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SOUTHWESTERN DIVISION 3915 PEELER ST. DALLAS 9, TEXAS

NEWS OF

Manufacturers—Suppliers—Engineering Firms

Serving the Petroleum Processing Industry

Personnel Changes

Mathieson Chemical Corp.—Harry P. Smith, formerly New York District Sales Manager, has been made Assistant General Manager of Sales. His heaquarters will remain in company's New York offices. S. L. Nevins has joined the organization as General Manager of the newly formed Ammonia Department; he will headquarter both in New York offices and at Lake Charles, La., ammonia plant.

Askania Regulator Co. — C. E. Tweedle, assistant to the president, has been elected a Vice-President.

M. W. Kellogg Co. — Ronald B. Smith, a consultant to the Atomic Energy Commission and a member of the National Advisory Committee for Aeronautics, has joined the engineering staff. His special fields include gas turbines, superchargers, condensers, oxygen plants, and power machinery.

Koppers Co., Inc. — Dr. Gilbert Thiessen, formerly development manager of the Chemical Division, has been named Technical Advisor for that division. Following graduation from the University of Pittsburgh in 1925 with a B. S. in Chemistry, he took graduate work at England's Sheffield University for one year and then returned to the University of Pittsburgh, where he received his Ph.D. in 1930.

Fluor Corp. Ltd.—Harold Gearin, previously with Shell Oil Co. and Bendix Aviation Corp., has joined the Los Angeles sales staff, and will shortly assume responsibility of Sales Coordinator among district offices on refinery and other construction projects. Lee Van Horn has been appointed Chief Process Engineer, with headquarters in Los Angeles. He has been connected with refinery process development for past twenty years on such processes as hyrdoforming, fluid catalytic cracking, and others.

Rockwell Mfg. Co.—C. B. Johnson has been named Chief Engineer and E. R. Gilmore, Director of Research, for company's **Pittsburgh Equitable Meter Division.** Mr. Johnson has been with **Nordstrom Valve Division** as chief engineer; Mr. Gilmore was formerly chief engineer of the meter and regulator division of Rockwell.

Alloy Steel Products Co. — H. E. (Hugh) Johnson, Chicago district manager, has been appointed Sales Manager, with offices at company headquarters in Linden, N. J.

Wm. Powell Co.—Joe L. Comer has been named Vice-President in Charge of Sales in the New York Area, with offices at 50 Church St., New York City. Previously, Mr. Comer was with Crane Co. and Culbert Pipe & Fittings.

National Supply Co. — Robert J. Casterton has been appointed sales representative in the Pittsburgh District Sales Office of National's Spang-Chalfant Division, succeeding the late William F. Hart.

Jessop Steel Co.—Frank B. Rackley has been named Vice-President in charge of Sales; he was formerly General Manager of Sales. Curtis A. Gordon, general works manager of Jessop, has been made Vice-President in charge of Operations.

Diamond Alkali Co — Otto L. Schweng has been appointed to the newly created post of Director of Market Research, with headquarters centered in the company's New York sales division at 570 Lexington Ave., New York City. He was previously with General Aniline and Film Corp. as Economic Specialist in the development department.

Patterson Foundry & Machine Co. —Donald Q. Kern has joined the company as Director of Engineering of the Process Engineering Division, to direct an expanding program in the design of processes and plants for the petroleum, petrochemical and heavy chemicals fields. Previously he was with Foster Wheeler Corp.

Kieley & Mueller—Al Bailey has been appointed General Manager, with headquarters at the company's plant at N. Bergen, N. J.

Branches, Distributors

Tube Turns, Inc. has opened a new warehouse at 317 So. Detroit, Tulsa, Okla., carrying a complete line of company's welding fittings and flanges. Personnel includes R. S. "Bob" Tyler, Mid-Continent district manager who formerly had his office at 311 Tuloma Bldg.; W. R. "Bill" Emrich, office manager; W. W. "Bill" Hamilton, Jr., warehouse manager; and Mrs. Bernice Coyle, secretary.

D. W. Haering & Co., Inc., have announced the opening of a new unit in San Antonio, Texas, providing space for increased laboratory facilities and greater warehousing.

Cooper-Bessemer Corp. has expanded national sales activities through the addition of a Chicago branch office at 122 So. Michigan Ave., in the People's Gas Bldg., under the direction of Robert S. Bowie.

Expansion, Transition

Instruments, Inc., a new firm manufacturing electronic and mechanical instruments, has been established in Tulsa, Okla. The company has been organized by O. W. Graham, who perfected the recently developed Gamma Ray level control instrument known as the Gagetron. Mr. Graham, who is President of the new company, worked in the Texaco Development Co.'s research laboratories under the direction of Dr. G. Herzog during the war, where he developed the Penetron.

Peerless Pump Division of Food Machinery Corp. has recently completed movement of personnel and equipment into its new 19-acre plant site at Indianapolis, Indiana, acquired late in 1946 from the War Assets Administration for a bid of $861,000. Works Manager is H. J. McKenzie; Assistant Works Manager is C. N. Adams.

Swift & Co. will begin operations this year in a new Industrial Oil processing plant at Hammond, Ind., on part of a 70-acre tract at 165th St. and Indianapolis Blvd., which is being set aside for further development of technical products facilities. New plant will include units to carry out three processes: solvent crystallization, solvent fractionation, and fat splitting. Among the many products will be lubricating compounds, insecticides, and cutting oils.

Clark Bros. Co., Inc., an affiliate of **Dresser Industries,** has entered into a long term agreement with **Fredric Flader, Inc.,** of N. Tonawanda, N. Y., under which the latter firm will do research development and design work for Clark on axial flow compressors and gas turbines. Clark expects to establish a wide market for the axial flow compressor in the petroleum and other fields.

PERSONALS

Petroleum Technologists in the Headlines

Chester F. Smith, vice president, Standard Oil Co. (New Jersey), is the new Vice President for Refining of the American Petroleum Institute, elected at the annual API meeting in November. He succeeds Dr. R. E. Wilson, chairman of the board, Standard Oil Co. (Indiana).

Mr. Smith

A native of New Jersey, Mr. Smith graduated from the University of Pennsylvania in mechanical engineering in 1913, working during summers for his present company. Engaged full time in the laboratory in 1913, he was made superintendent of case and can operations at the Bayonne refinery in 1915 and successively became assistant to the general superintendent, general superintendent and, in 1928, general manager.

In 1931 he was made assistant general manager of the three New Jersey refineries and in 1933 vice president, director and general manager in charge of manufacturing for the Delaware subsidiary. In 1940 he was elected president of the Delaware company and in 1944 he was made a director of the New Jersey company and, in 1946, vice president of that company.

* * *

M. E. Spaght, vice president of Shell Development Co., becomes president as of Jan. 1, 1949, succeeding A. E. Lacomble, who has been elected chairman of the board.

Mr. Spaght

He studied at the University of Leipzig and received his Ph.D. in chemistry from Stanford University. He has been with Shell for 15 years, starting as research chemist in the Martinez refinery, and by 1940 had become manager of Shell Oil Co.'s manufacturing research and development in San Francisco. During the war he supervised the expansion of Pacific Coast refining facilities for wartime production and in 1945 went to Europe and Japan as a member of U. S. technical groups. He was then made manager of manufacturing for Shell west of the Rockies and in 1946 was appointed vice president of Shell Development Co.

* * *

Vladimir A. Kalichevsky, Beaumont, Texas, consulting chemical engineer for Magnolia Petroleum Co.'s Refining Division, is one of the three nominees for president-elect of the American Chemical Society. He has been a member of the Society since 1923, from 1929 to 1938 participated in the publication of its "Chemical Abstracts" and is now a councilor for the ACS Texas-Louisiana Gulf Coast Section.

Born in the Caucasus region of Russia, Mr. Kalichevsky received his B. S. in chemical engineering from California Institute of Technology in 1924. He has served as research chemist for various oil companies and, prior to taking his present position in 1944, was general supervisor of the Research and Development Department of Socony-Vacuum Oil Co., Inc. He is the author of well known scientific books for the petroleum industry.

Trained in his youth in the War College of Russia, Mr. Kalichevsky was a Captain in the Imperial Russian Guards in World War I and fought against the Leninist government in 1919-20, receiving both French and Russian decorations.

* * *

Robert A. Cunningham, Kerrville, Texas, senior mechanical engineering student at Rice Institute, has been awarded the American Petroleum Institute Houston Chapter scholarship for 1948.

* * *

Dr. Gilbert Thiessen, formerly development manager of the Chemicals Division, Koppers Co., Inc., has been named technical advisor of that division.

* * *

R. M. Hooker, chairman of the board, Hooker Electrochemical Co., was re-elected a board member of the National Industrial Conference

Sulfur in Petroleum Is Meeting Topic

Dr. O'Kelly

Features of the 1949 spring meeting of the Petroleum Division of the American Chemical Society in San Francisco will be symposiums on "Organic Sulfur Compounds As Related to Petroleum" and on "Micro Chemistry and the Petroleum Industry", it is announced by **Dr. W. E. Kuhn,** New York, manager of the Technical and Research Division, The Texas Co., chairman of the Division.

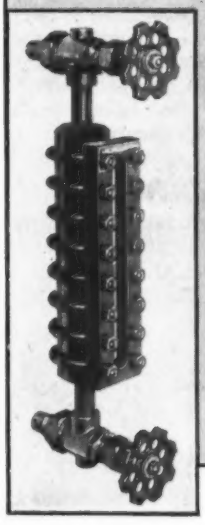
Mr. Levin

The program on sulfur compounds has been planned to emphasize the fundamental chemistry of such compounds occurring in or produced with petroleum. Papers will be presented by several industrial and research organizations and will cover the occurrence, identification and analysis of sulfur compounds in petroleum, effects of such compounds on metals and on the properties of products, recent developments in removal of sulfur from crude and refined stocks, and the production of sulfur compounds as chemicals from petroleum. This program is in charge of **Dr. A. A. O'Kelly,** associate director of Socony-Vacuum's Research and Development Department, who will be chairman of the symposium.

The second symposium on Micro Chemistry will be sponsored jointly by the ACS Petroleum and Analytical and Micro Chemistry Divisions. The subject matter will include micro physical techniques, micro chemical analyses and syntheses, training of micro chemists and so on. This program is under the direction of **Harry Levin,** supervisor of the Analytical and Testing Department, Beacon Research Laboratories, The Texas Co.

A. L. Lyman, vice president and director of laboratories, California Research Corp., is local chairman of arrangements for the San Francisco meeting. The date of the 1949 spring meeting is March 28-April 1.

When Liquids Boil and Surge the new JERGUSON LARGE CHAMBER GAGE Will Give You A Level Reading



WHEN liquids boil and surge, and use of a coolant is undesirable, the New Jerguson Large Chamber Gage will give you a level reading.

Ordinary gages do not give sufficiently accurate readings on such liquids where the level fluctuates rapidly in the glass. With this new Jerguson, however, the gage chamber is of such large diameter that the level is not badly upset by the boiling action of the fluid. This makes it possible to get close level readings, the kind of readings you want for safety and accurate control.

Don't be satisfied any longer with gages that require you to *guess* at level readings. If liquids boil, install Jerguson Large Chamber Gages and *be sure.*

The Jerguson Large Chamber Gage is the flat glass, reflex type. Write for full information on this and other Jerguson Gages.

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Board, non-profit institution for research and education in economic and business fields. He was first elected a board member in 1938.

* * *

H. L. Moir, technical advisor, Pure Oil Co., Chicago, has been nominated for vice president, fuels and lubricants, of the Society of Automotive Engineers for 1949.

* * *

Ben G. Symon, manager of the lubricants department, Shell Oil Co., New York, was elected president of the National Lubricating Grease Institute at its recent annual meeting. A graduate of the University of Missouri in mechanical engineering, he joined Shell in 1928 as a lubrication engineer. He became manager of the technical products department in 1937 and in 1940 was put in charge of technical products sales east of the Rockies. He was named manager of the lubricants department in 1942.

Mr. Symon

A. J. Daniel, Battenfeld Grease & Oil Corp., Kansas City, is the new vice president of the NLGI; **E. V. Moncrief,** Swan-Finch Oil Corp., New York, treasurer, and **H. F. Bennetts,** executive secretary.

* * *

Oscar H. Fager heads the new Special Products Division of Roosevelt Oil & Refining Corp., Mt. Pleasant, Mich. His work will have to do with technical applications of the refinery's short boiling range hydrocarbons, petroleum polymers, technical white oils, petroleum waxes and so on.

Mr. Fager

Mr. Fager comes to the company from the Petroleum Specialties Co., St. Louis. His background of experience in petroleum products includes work in the Navy and with Shell Oil Co. and other oil companies.

* * *

Roy S. Bonsib, safety director, Standard Oil Co. (New Jersey), was given a testimonial dinner at the meeting of the Petroleum Section at the National Safety Congress in Chicago. Oct. 18-22. This was the 17th meeting for the Petroleum Section, which Mr. Bonsib helped to establish.

Charles F. Sanderson, College Station, Texas, has formed a consulting engineering partnership with **Alen F. Glendening,** Houston, specializing in process and equipment design, preparation of flow sheets and complete reports for the light hydrocarbon and organic chemical industries. Offices will be at College Station.

Mr. Sanderson

Mr. Glendening

Mr. Sanderson, now completing doctorate requirements under a Gulf Oil Co. graduate fellowship in chemical engineering at Texas A & M College, has had six years industrial experience, divided among Celanese Corp., Lummus Co. and Petroleum Engineering, Inc. He also assisted in economic process evaluation of government-owned synthetic rubber and "avgas" plants while a candidate for the master's degree at A & M, and is a registered engineer of Texas.

Mr. Glendening was born in 1923 in Paris, coming to the U. S. in 1925. He graduated from Princeton University as an electrical engineer in 1944. His industrial experience began with Petroleum Engineering, Inc. at Houston the following year as a process engineer, which company he leaves to become the junior partner in the Sanderson-Glendening firm. He will continue to reside in Houston.

* * *

Dr. James W. McBain, professor of chemistry at Stanford University, in

Shell Glycerine Plant Wins Engineering Award

For the first commercial production of synthetic glycerine, Shell Development Co., research affiliate of Shell Oil Co. and Shell Chemical Corp., received the 1948 award for Chemical Engineering Achievement sponsored by Chemical Engineering magazine. The presentation was made at a dinner in New York Nov. 10.

The Shell plant, at its Houston Refinery, was opened Sept. 16, synthesizing glycerine from propylene from refinery gases.

CORROSION PROTECTION INDEPENDENT OF...

POWER SUPPLY

FREQUENT MAINTENANCE

REGULATION

WEATHER

Install the cathodic protection for your pipe lines . . . that you can bury and let work for you . . . Alcoa Anodes. These simple, self-contained power sources provide uniform corrosion protection, regardless of location. They are self-regulating, won't damage pipe coverings by excessive current. Storms do not interfere with their operation.

The installation cost of Alcoa Anodes is frequently less than that of other systems. Minimum problems of interference with nearby buried structures is an additional advantage.

Cast from specially compounded alloys to give maximum protection per pound of metal, Alcoa Anodes are available in sizes to meet your needs, for prompt shipment. ALUMINUM COMPANY OF AMERICA, 626 Gulf Building, Pittsburgh 19, Pennsylvania. Sales offices in 55 principal cities.

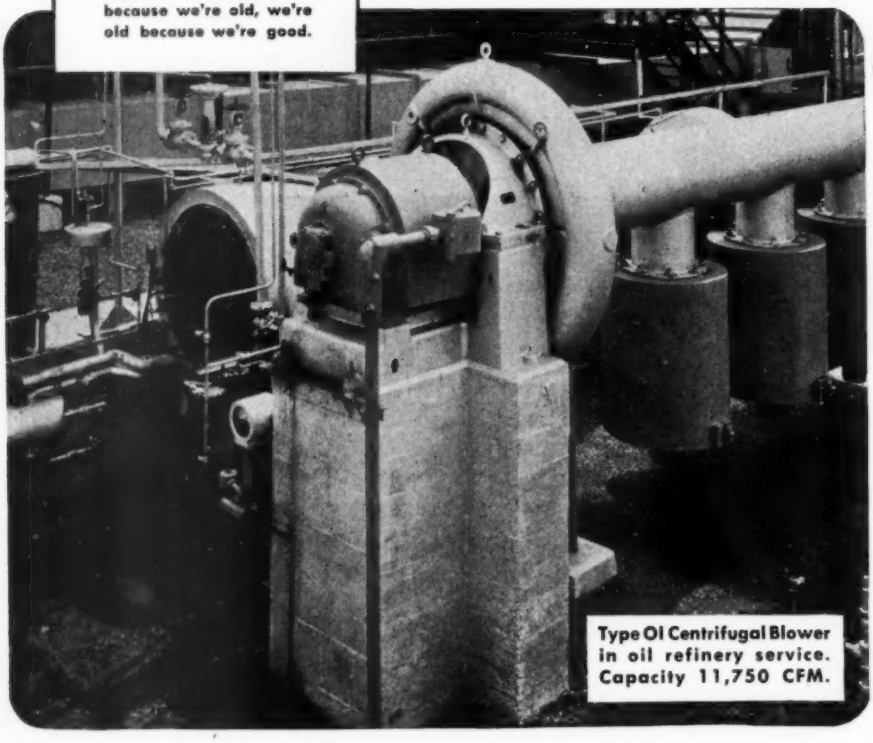
Magnesium ANODES by ALCOA

ALCOA ALUMINUM

Oil was first produced by drilling in 1859, five years after the first Roots Blower was built. We're not good because we're old, we're old because we're good.

The ANSWER to GAS-MOVING jobs . . .

R-C dual-ability



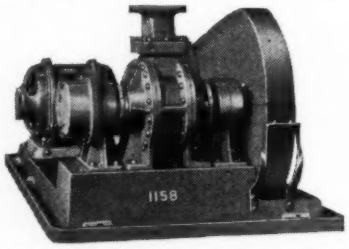
Type OI Centrifugal Blower in oil refinery service. Capacity 11,750 CFM.

For various petroleum refining and processing operations, Roots-Connersville Blowers, Exhausters and Gas Pumps are available in sizes and types exactly matched to the job to be done.

That's because of our *dual-ability* to recommend, without bias, and to supply either Centrifugal or Rotary Positive units, whichever best meets the specific needs. We are the only blower builders offering this *dual choice.*

Our smaller size Cycloidal Rotary units have proved especially successful for slack wax pumps and similar work. R-C Meters measure gas input or output with "cash register" accuracy.

Tell us your specific problems . . . and R-C *dual-ability* will help you find practical answers.



R-C Cycloidal Rotary Pumps can handle gas or vapor along with liquids, without loss of efficiency. They can be relied upon for long-time, economical operation.

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ROOTS-CONNERSVILLE ROTARY CENTRIFUGAL — BLOWER BUILDERS R-C SINCE 1854

BLOWERS · EXHAUSTERS · BOOSTERS · LIQUID AND VACUUM PUMPS · METERS · INERT GAS GENERATORS

ONE OF THE DRESSER INDUSTRIES

Personals

November delivered a two weeks series of lectures to technical and research workers at Humble Oil & Refining Co.'s Baytown refinery.

* * *

Henry D. Noll has been appointed manager of the Houdry Engineering and Technical Service Division, Houdry Process Corp., Philadelphia, serving under Dr. C. C. Peavy, vice-president in charge of engineering and sales.

Mr. Noll

He attended the University of Colorado and the University of Pittsburgh, and holds a degree in petroleum engineering. He began his career with the Standard Oil Co. of New York, and after three years was transferred to Magnolia Petroleum Co. at Beaumont, Texas. He went to Socony-Vacuum's research and development laboratories at Paulsboro, N. J. in 1938, where he was placed in charge of both thermal and catalytic cracking.

During the war, Mr. Noll held assignments in Socony's manufacturing department in New York and was a member of the PAW Aviation Gasoline Advisory Committee.

In his previous activities with Houdry, he has served as manager of the Project Analysis Department and as a technical consultant for Houdry licensees on war-to-peace conversion problems, equipment modernization, and catalytic cracking installations.

* * *

Dr. Ernest F. Fiock is chief of the newly organized combustion section of the National Bureau of Standards. He joined the bureau's staff in 1926.

* * *

Dr. Charles E. Moser, supervisor, fuels development research, The Texas Co., Beacon, N. Y., has been elected chairman of the Mid-Hudson Section of the American Chemical Society, succeeding **Ernest A. Rodman,** E. I. du Pont company.

The 1948 Index

As was done last year, the 1948 Subject and Author Index of all editorial material appearing in PETROLEUM PROCESSING will be published as a separate bulletin of the same folio size as the magazine, for convenience in filing. It will be supplied to readers upon request, without cost. Readers may now send in their orders for copies of the Index.

Lester M. Goldsmith, chief engineer for the Atlantic Refining Co., Philadelphia, was awarded the President's Certificate of Merit for his services in World War II. He served during 1942-44 with the transportation division of the National Defense Research Committee, Office of Scientific Research and Development.

* * *

Dr. H. J. Broderson, with Standard Oil Co. (Indiana) and its Pan American Refining Corp. subsidiary for 31 years, has retired. He had been general superintendent of the latter's Texas City refinery since 1934.

* * *

Raymond B. Faller is coordinator of employe training activities in the industrial relations department of Ethyl Corp. He was formerly manager of employe relations in the Ethyl research laboratories at Detroit.

* * *

D. A. Klemme, safety supervisor of Stanolind Oil & Gas Co., is the new chairman of the Petroleum Section of the National Safety Council.

CLASSIFIED

Positions Open **Positions Open**

REFINERY SUPERVISORS WANTED

Shortly after the first of the year The Pure Oil Company will complete a modern lubricating oil manufacturing plant near Beaumont, Texas.

Several excellent opportunities will be available to men capable of:

Supervision of Vacuum Distillation
Supervision of Propane Deasphalting
Supervision of Phenol Extraction
Supervision of Solvent Dewaxing
Supervision of Contact Finishing

If you are interested please supply a resume of your experience and photo in your initial reply.

THE PURE OIL COMPANY

Personnel Department

35 East Wacker Drive **Chicago 1, Illinois**

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EDITORIAL VIEWPOINTS...

Opinions and Comments on Current Topics

Refiner's 1948 Dollar Buys Less Than Private Citizen's Dollar

MISCONCEPTIONS regarding oil company earnings in the present inflationary period occur among oil industry workers as well as within the public. The companies have endeavored to overcome this misunderstanding by factual statements to their employes, and to this same end Reese Taylor, president of Union Oil Co. of California, appeared before the recent meeting of the California Natural Gasoline Assn. in Los Angeles.

Speaking to plant operators and engineers, Mr. Taylor showed that, because of the high cost of materials and new construction, the oil company's 1948 dollar, when it comes to plant construction and upkeep, is worth 53c on the basis of what a dollar would buy in 1941. This is 6.5c below the value of the average citizen's dollar in terms of his purchases. New and revamped plant facilities require a 50% higher investment than in 1941. Yet such improvements must come, said Mr. Taylor, before wages and dividends to stockholders can be increased.

More oil companies could interpret their earnings statements in terms of what their dollars will actually buy, to show that a dollar today is no more a dollar to them than to anyone else.

Refiners' Work on Smog Problem May Prove of Wide Public Service

THE refineries in the Los Angeles area on the West Coast, charged by county authorities with being the principal source of the "smog" nuisance there, are continuing their fundamental studies in the problem, even though the work thus far shows their own gaseous wastes are not a chief contributing cause.

The ultimate findings of their research may greatly benefit other highly industrialized points over the country where this peculiar set of weather conditions occurs in which natural haze and man-made contaminants of the air mingle to produce an unpleasant, murky atmosphere. Even greater hazards may result, as in the case of the Donora, Pa., disaster.

More than a year of research sponsored by the Los Angeles oil companies and carried on at Stanford Research Institute has achieved definite advances towards the solution of the smog problem. More is known of the combination of meteorological conditions associated with smog; a method has been developed for forecasting when smog will appear; means have been worked out for measuring low concentrations of suspected irritants in the atmosphere.

The work so far brings out that sulfur dioxide, in the range of concentrations present in the Los Angeles atmosphere, is not a factor in decreasing visibility and is not an eye-irritant. The refineries have been said to be the chief source of sulfur compounds in the atmosphere. It is now believed that elemental sulfur in the air may be one principal source of the eye-smarting which appears to be a peculiarity of the Los Angeles smog. Further research at Stanford will endeavor to learn the source of this contaminant and the form in which it is present.

The joint research on smog at Stanford is sponsored by the Committee on Smoke and Fumes of the Western Oil and Gas Assoc., its members including representatives from Union Oil Co. of California, Standard Oil of California, Richfield Oil, Tidewater Associated, Shell Oil Co., General Petroleum Corp., The Texas Co. and the Independent Refiners Assoc. of California, Inc. Two years ago these same refiners embarked on a concerted program of fume and smoke control in their own plants which has produced important results and is still in progress.

Their program includes the following steps: ceasing to burn acid sludge; switching from fuel oil, which contains sulfur, to natural or refinery gases for the operation of their refineries; processing of refinery gases to remove mercaptans, thus recovering sulfur compounds which formerly escaped into the air; processing refinery gases to remove hydrogen sulfide. As a result of these voluntary steps, less sulfur dioxide is entering the atmosphere from Los Angeles refineries than at any time before the war.

The work on the smog problem is a fine example of cooperation among oil companies in an effort in the public service which is far wider than any range of their own operating problems.

Natural Gasoline Agencies Work Together on Technical Problems

THE PRESENT WORK of the Natural Gasoline Assn. of America and the California Natural Gasoline Assn. in rewriting and unifying their test methods for liquefied petroleum gas is another example of the manner in which these two trade associations have coordinated their efforts to the benefit of the natural gasoline and cycling industry which they both serve.

Technical representatives of both bodies regularly serve on the same committees on special projects. Official representatives of each attend the conventions of the other. Some of their technical standards for natural gasolines were worked out jointly; in other cases methods developed in one group were adopted by the other, altered as necessary to meet the differing marketing conditions of the geographical areas they represent. Problems individual to the member companies of each association are worked out separately.

Unquestionably, through this association cooperation, many knotty technical problems have been solved more quickly than if each had proceeded separately. Conflicts between test methods have been avoided. Present product specifications of the two agencies for the same materials do not differ to any important degree.

Through their teamwork, sometimes achieved by putting aside personal differences, each association has been of greater service in technical matters to the natural gasoline and cycling industry than as if they had gone it alone.

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BR -- Book Reviews
Ed -- Editorials
EP -- Equipment Patents
LP -- Laboratory Practices
PP -- Plant Practices
PT -- Patent Trends
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BR -- Book Reviews
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EP -- Equipment Patents
LP -- Laboratory Practices
PP -- Plant Practices
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EP — Equipment Patents
LP — Laboratory Practices
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